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SOME FACTORS INFLUENCING THE LOCAL DISTRIBUTION AND ABUNDANCE OF WOODLAND SMALL MAMMALS IN CENTRAL NEW YORK

BY E. W. JAMESON, JR.

Biologists often consider a certain plant or animal as belonging to a special habitat or ecological niche. By describing these habitats one attempts to indicate where certain animals may and may not occur. This discontinuous distribution of an animal (within its geographic range) is considered its ecological distribution. Although some animals are rather widespread ecologically, others may frequently be confined to one or a few habitats. The environmental factors which make one habitat favorable to an animal may not be as obvious as is the dominant flora which one recognizes as belonging to a specific habitat. To discover and define the ecological distribution of an animal is a primary step in the study of its natural history.

From January 1947 until July 1948 small mammals were trapped in wooded areas in central New York. Certain kinds of mice and shrews were found to be more common in some of these woodlands than in others, and some occurred regularly in all of the areas studied. This investigation was made with the hope of finding some causes for the interrupted distributions of some of the small mammals encountered in these woodlands.

METHODS

Environmental factors to be considered.—Many life history studies of small mammals have shown that they feed on a great variety of plant foods. Hamilton (1930, 1941) described in detail the versatile food habits of some species of shrews and mice. Because of this ability to subsist on a diversity of small invertebrates as well as seeds and herbaceous plants, the specific kind of food is perhaps not important in limiting the local distribution of these mammals. Many discussions on the ecological distribution of small mammals imply, intentionally or not, that the association of certain plants and animals is a causal one: that is, the plants of a given area determine what kinds of small mammals will live there. Although such a situation may sometimes actually obtain, this association of plants and animals may be due to some non-biological part of the environment. The non-biological feature of the habitat may determine the presence of both the

plants and animals living there; although they would have no obligatory relationship with one another, they would frequently be found living side by side. This is assumed to be the case when an investigator states that an animal is characteristic of the "beech-birch-maple climax community." It is implied that the animal actually seeks these trees and then makes its home in such a habitat. Quite possibly the actual ground cover, more than the obvious canopy overhead, determines local distribution. Because the implied role of vegetation is rather nebulous, factors other than botanical have been considered in this study.

The moles, shrews, and mice collected in this study utilize tunnels, made by some of them, through the humus layers of the soil. It seemed desirable to examine this part of the soil as a habitat requirement for these mammals. The local distribution of small mammals with respect to edaphic factors has been studied by American investigators chiefly in the west. These studies have been concerned with both the color and physical and chemical natures of the soil. The more important papers are briefly summarized by Hardy (1945). He found that, in southwestern Utah, soil chemicals affect mammals only through their effect upon the plants; but that the texture of the soil did affect the local distribution of mammals, especially the burrowing forms. Hall (1946: 48) briefly treated some of the factors which influence the local distribution of mammals in Nevada. He observed that soil was of considerable importance for some mammals, and attributed some significance to plants. In the arid west, plants may be a greater selective force than in the eastern United States where vegetative growth is comparatively lush.

Temperature and relative humidity doubtless contribute to the suitability of a woodland as a home for small mammals. A few temperature and relative humidity readings were taken both in small mammal burrows and on the ground. Although these data give some idea of the conditions in which the small mammals live, the information obtained in this study is insufficient for evaluating the role of these factors in habitat selection.

The differences in altitude were not great and this factor will not be considered. Spaeth and Diebold (1938: 73) concluded that in this region the effect of altitude on soil temperatures is largely obscured by the type of cover and exposure.

The environmental factors which determine the local distribution of an animal are many. Only a few possible factors are discussed in the present report. The species included in the study are listed in Table 1.

Trapping.—Various areas were selected with the aim of contrasting wooded habitats in which the small mammal faunas were not the same. When differences in the composition of the populations or population levels were established, it was endeavored to learn what might have caused such variations. Snap traps were used exclusively, and the data were compiled according to the trap-night method. One trap exposed for one night was counted as one trap-night. The traps, baited with walnut meat, were placed crosswise in underground runways and about stumps at the entrances of burrows. Sometimes the traps were left out for only a single night; more often they were left in place for two, three, or even four nights. Usually there was a reduction in the catch after the first

night, but in some instances there was an increase. The average take (for 100 trap-nights) for first nights was 15.1 small mammals, 10.2 for second nights, 7.2 for third nights, and 6.5 for fourth nights (averages of more than ten thousand trap-nights). Mohr (1943) stated that the catch is not markedly reduced until after the third night. This is probably influenced by the size of the original population, greater populations not manifesting a reduction until later. As

TABLE 1.—*Kinds and numbers of small mammals captured*

SPECIES	1947	1948	TOTAL
Parascalops breweri (Bachman)	5	14	19
Condylura cristata (Linnaeus)	2	0	2
Sorex cinereus Kerr	6	3	9
Sorex fumeus Miller	97	157	254
Blarina brevicauda (Say)	294	209	503
Peromyscus maniculatus (Wagner)	2	3	5
Peromyscus leucopus (Rafinesque)	154	85	239
Clethrionomys gapperi (Vigors)	32	38	70
Pitymys pinetorum (LeConte)	12	15	27
Napaeozapus insignis Miller	47	30	77
Totals	651	554	1205

TABLE 2.—*The number of individuals per 100 trap-nights (representing averages of trap-nights in table 4)*

AREA	A		B		C		D		E		F	
Year	'47	'48	'47	'48	'47	'48	'47	'48	'47	'48	'47	'48
Condylura	—	—	0.1	0.0	0.1	0.0	—	—	—	—	—	—
Parascalops	—	—	—	—	0.0	0.2	—	—	0.4	0.0	0.3	1.7
Sorex cinereus	—	—	0.7	0.2	—	—	—	—	0.0	0.1	—	—
Sorex fumeus	3.3	3.5	2.0	1.7	2.3	2.6	2.5	5.5	0.9	2.8	0.1	1.0
Blarina	6.8	3.8	5.2	1.9	5.0	2.8	7.2	5.5	6.4	4.0	7.6	6.4
Peromyscus[1]	1.6	1.4	3.0	0.9	0.2	0.4	4.3	2.2	3.1	1.5	9.6	4.2
Clethrionomys	0.4	0.5	0.7	0.7	0.6	0.5	2.2	1.9	1.3	1.4	—	—
Pitymys	—	—	—	—	—	—	0.5	0.1	0.7	0.4	0.8	1.4
Napaeozapus[2]	2.9	0.5	2.2	0.8	1.1	0.1	0.3	0.5	0.5	0.1	0.6	0.7

[1] *P. maniculatus* and *P. leucopus*.

[2] Compiled on data when *Napaeozapus* was out of hibernation.

the method of trapping did not vary from one area to another, the data are comparable. Stickel (1948) pointed out the danger in such a procedure; and if one were to take the following data too literally, he might be misled. However, the figures on the numbers of small mammals recorded here are considered generally of value, and, where possible, they have been substantiated by small mammal "sign." Winter trapping (usually conducted under considerable snow cover) was more laborious than summer trapping. Accordingly, fewer traps could be set during the winter if trapping was to be equally effective throughout the year.

Recent studies reflect some disagreement concerning the relative merits of the numerous methods of censusing small mammals. Taylor (1930: 526) found that some species were caught more readily with snap traps, and that live traps were more efficient for other species. Goodnight and Koestner (1942) and Gray (1943) found the two types to be about equally useful. In an experiment designed to determine the reliability of the two methods for indicating the absolute density of small mammal populations, Stickel (1946) concluded that snap trap methods are invalid, and (1948) that a trapline does not give an accurate measure of the numbers of small mammals. She worked with *Peromyscus leucopus*.

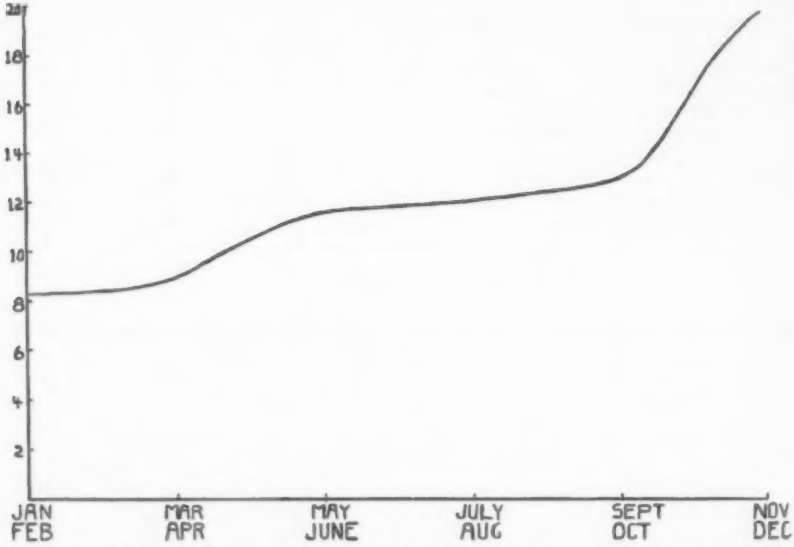

FIG. 1.—The annual increase in woodland small mammal populations in central New York. The genera included are *Sorex*, *Blarina*, *Peromyscus*, *Clethrionomys*, *Pitymys*, and *Napaeozapus*. Figures on the ordinate are the numbers taken per 100 trap-nights.

Granted that the trapline does not give as accurate an idea of the numbers of small mammals as the live trap method, it nevertheless indicates the relative abundance of a species in different areas. Moreover, snap traps have the advantage of taking moles and other subterranean species. Live traps would have been quite unsuitable for fossorial species and winter trapping.

Season of trapping.—The populations of small mammals change markedly from season to season. Hamilton (1942: 217) found the numbers of small mammals in central New York woodlands to be two to five times greater in the fall of the year than in the following spring. By trapping small mammals alive Evans (1942: 185) captured a greater number of *individuals* of mice (*Apodemus sylvaticus* and *Clethrionomys glareolus*) in early winter than at other seasons.

Burt (1940: 40) demonstrated this same phenomenon for *Peromyscus leucopus*. Such studies strongly suggest that the abundance which follows the breeding season and continues into late fall or early winter is actual and not due to a greater predilection of the animals for bait or to a greater activity at times of suddenly lowered temperatures. Although this annual fluctuation might at times be obscured by a cycle of greater duration, it is apparently a fundamental annual occurrence in populations of some species of small mammals, at least in temperate regions (Fig. 1).

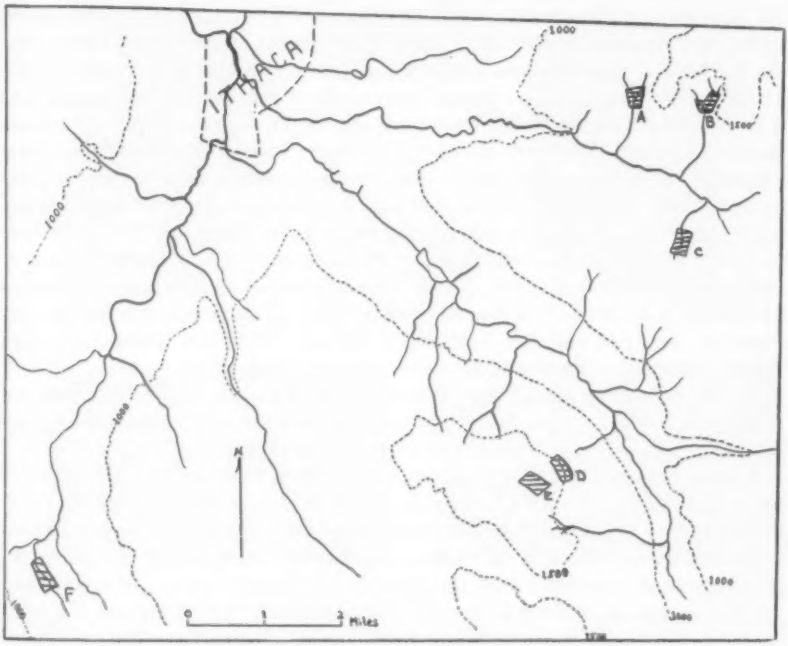

FIG. 2.—The vicinity of Ithaca, New York, and the six areas investigated in this study.

DESCRIPTION OF THE REGION

The areas in which this study was made were all within Tompkins County, New York, seven miles or less from Ithaca. The exact areas are indicated on Figure 2. These areas can be located on the Ithaca and Dryden Quadrangles of the United States Geological Survey (U. S. Dept. Interior, 1900 ed.) maps. Topographically the region consists of rather straight, broad valleys the tributaries of which are narrow ravines; this is a part of the Allegheny Plateau.

All the study areas are within eleven miles of each other, and the variation in altitude is slight; the altitudes ranged from 650 to 1700 feet above sea level. The climate of New York State has been summarized by Mordoff (1934). The

last killing frost averages about May 10, and the first killing frost in the fall averages about October 1. The duration of the growing period is about 145 days. The mean annual minimum temperature is 15 to 20 degrees Fahrenheit (January), and the mean maximum is from 80 to 85 degrees Fahrenheit (July). The mean annual precipitition is between 30 and 40 inches, and the snowfall is between 40 and 60 inches. Because of a reduced drift, the snow in the woodlands is deeper than in the adjacent open areas, and this has a modifying effect upon soil temperatures in the winter (Spaeth and Diebold, 1938).

Central New York occurs in the Canadian and Transition (Alleghenian) Zones of Merriam, and in the Canadian Province of Dice. Livingston and Shreve (1921) studied the distribution of some higher plants in the United States, and, on the basis of humidity and temperature factors, outlined nine vegetative districts. There has been no corresponding study of mammalian distribution, and I do not know how significant their work may be as regards the present investigation. Central New York lies in the Northern Mesophytic Evergreen Forest (East) of Livingston and Shreve. The principal woody vegetation on the study areas consists of hemlock (*Tsuga canadensis*), oaks (*Quercus borealis*, *Q. velutina*, and *Q. montana*), hop hornbeam (*Ostrya virginiana*), blue beech (*Carpinus caroliniana*), beech (*Fagus grandifolia*), maples (*Acer nigrum*, *A. rubrum*, and *A. pennsylvanicum*), witch hazel (*Hamamelis virginiana*), hobblebush (*Viburnum alnifolium*), arrowwood (*Viburnum acerifolium*), wintergreen (*Gaultheria procumbens*), and partridgeberry (*Mitchella repens*). Moisture, humus, and slope seem to determine the vegetation in the various areas.

A thin deposit of glacial drift occurs on the uplands. Elsewhere there are either glacier-laid or water-laid deposits. The soils are of several types of stony silt loam and stony clay loam in the areas studied (Howe *et al.*, 1924).

A layer of humus covers the soil in most of the wooded areas. The depth of the humus varies with the topography. Humus layers are of two general types in the forested regions of eastern United States: *mor*, in which the organic matter is distinctly separated from the upper mineral layer; and *mull*, in which the organic materials are mixed with the mineral soil directly below. Mor and mull are divided into several kinds, and these are described by Heiberg and Chandler (1941). The nature and amplitude of the humus is variable. Mor is held together in a firm dense mat by a network of fine roots and fungus hyphae (Pl. I). Matted mor can be cut with a knife and will remain intact after the loose particles have been shaken from it. Mull contains no such tightly woven network and is quite friable (Pl. I). In the late summer small piles of the midribs of leaves are conspicuous signs of the activities of earthworms, characteristic inhabitants of mull (Pl. I). Near watercourses muck soil usually predominates.

Six areas were selected for study; they are roughly rectangular and from 30 to 40 acres each in extent. These areas are wooded and show no evidence of recent grazing or extensive logging (Pl. II). Four of the areas are ravines whose creeks contain water throughout the year, and two are the slope and the summit of a hill. Each area is surrounded on at least two sides by a continuous area of similar topography and cover. There are no barriers to prevent an inward drift

of small mammals, and this minimized the likelihood of the first year's trapping reducing the breeding population of the subsequent year. These areas are designated A, B, C, D, E, and F.

Area A is a ravine five miles east of Ithaca. The altitude ranges from 1200 to 1300 feet, and the slope is about 6.5°, the exposure being to the south. The mineral soil is Lordstown stony silt loam which is derived from glacial till (Howe *et al.*, 1924: 1582). The humus is matted mor and varies from one to one and a

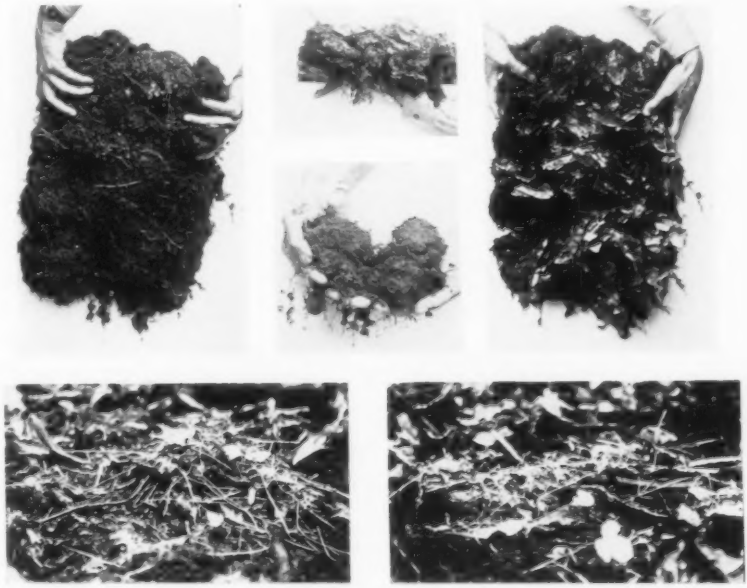

PLATE I

Humus layers. Upper left, upper right, and upper center, matted mor; lower center, coarse mull; lower, left and right, skeletal remains of leaves left by earthworms

half inches in depth. Adjacent to the stream are areas of fine muck soil deposited by surface runoff from the sides of the ravine.

The most numerous trees are hemlock (*Tsuga canadensis*), red oak (*Quercus borealis*), chestnut oak (*Quercus montana*), hop hornbeam (*Ostrya virginiana*), hard maple (*Acer nigrum*), red maple (*Acer rubrum*), and white ash (*Fraxinus americana*). Most common of the shrubs are witch hazel (*Hamamelis virginiana*), arrowwood (*Viburnum acerifolium*), and flowering dogwood (*Cornus florida*). Wintergreen (*Gaulthreia procumbens*) and partridgeberry (*Mitchella repens*) are also common. Covering the ground is an accumulation of litter consisting of the dried remains of the above plants.

Area B is a ravine six miles east of Ithaca. The composition of the vegetation, the humus, and the soil are similar to those of Area A.

Area C is a ravine directly opposite B. The altitude varies from 1180 to 1400 feet, and the slope is 8.3° to the north. The soil is Lordstown stony silt loam;

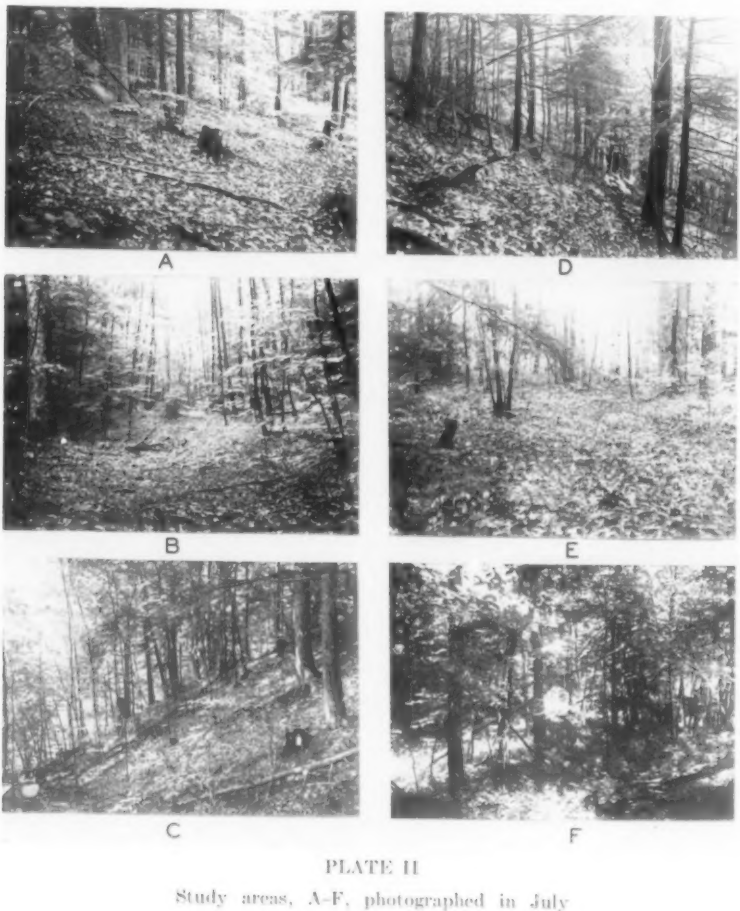

PLATE II

Study areas, A–F, photographed in July

this is covered by a two to three inch layer of matted mor. The woody vegetation is similar to that of Area A, but differs in having black and yellow birches (*Betula lenta* and *B. lutea*) among the dominant trees. Hobblebush (*Viburnum alnifolium*) is conspicuous in this area.

Although Areas A, B, and C differ in some features, their general facies are quite similar in contrast to the following three areas. The altitudes, soil, humus,

and vegetation are approximately the same. There are occasional rock outcrops near the creeks. Area C differs from A and B in having a deeper humus, a northern exposure, and a flora of more boreal affinities.

Area D is the northeast slope of a hill seven miles southwest of Ithaca. It lies between 1300 and 1500 feet with a 30° grade. The soil is Lordstown stony silt loam, but the humus (mor) occurs only in scattered patches. A litter of leaves, hemlock needles, and twigs fill the depressions caused by the uprooted trunks of fallen trees. Elsewhere the mineral soil lies exposed. The woody vegetation is like that of Area A, but black birch and striped maple (*Acer pennsylvanicum*) are relatively common.

Area E is a flat wooded section on the summit of the above hill; the elevation is 1700 feet. The soil is Lordstown stony silt loam; in some parts this is replaced by Volusia stony silt loam. The humus (matted mor) is from three to five inches deep. Coarse mull is the humus in certain parts of Area E. The woody vegetation includes those species on Area D with the addition of such austral species as tulip tree (*Liriodendron tulipifera*) and cucumber tree (*Magnolia acuminata*). In the Ithaca region these trees are characteristic of rich soils. The humus in Area E has been much tunneled by small mammals, but these tunnels are not so close to the surface as they are in Areas A, B, and C.

Area F is in marked contrast to the others. This area is the narrow level bottom of a wooded ravine. The altitude is 650 feet. The soil is Dunkirk silty clay loam which is derived from lake-laid sediments and quiet water deposits (Howe, *et al.*, 1924: 1584). The humus is coarse mull, and the ground litter is scanty. This is a woodland of broad-leaved deciduous trees: basswood (*Tilia americana*), white ash (*Fraxinus americana*), hard maple (*Acer nigrum*), and tulip tree (*Liriodendron tulipifera*) predominate.

SMALL MAMMAL BURROWS

From many excavations made in this investigation it appeared that most of the underground passages used by small mammals are close to the surface. Eadie (1939: 153) found that the shallower burrows of *Parascalops breweri* were much more extensive than those which descended below the humus. Perhaps these tunnels serve to conceal their inhabitants from predatory animals. In this sense they are counterparts of the paths made by *Microtus pennsylvanicus* through dense grassy growth. However, the tunnels of the woodland small mammals are often four or five inches below the surface litter. Frequently they course through the lower humus strata (of mor) so that they lie just on top of the mineral soil, following its contours. Apparently they are made as deep as possible without penetrating the compact soil underlying the humus. Occasionally burrows descend into the mineral soil, and perhaps these lead to nests or food stores.

That these passages are deeper than necessary for mere concealment from enemies suggests that they have an additional function. Temperature and relative humidity readings indicate that they afford a cooler and more humid environment for their inhabitants. On May 17, when the air temperature was 65

degrees Fahrenheit, a tunnel six inches below the litter of the forest and just on the surface of the mineral soil was 45 degrees. In the summer a depth of three or four inches usually accounted for eight or ten degrees lowering of the temperature in the burrows. In the winter, when there was a foot or more of snow on the ground, the temperature in the tunnels varied little from 32 degrees. In summer months the relative humidity ranged from 84 to 93 in the air in woodlands (on clear days), but it was virtually 100 in the small mammal tunnels. These conditions are much the same as those recorded by Hamilton (1940: 476) in woodlands where he trapped *Sorex fumeus*.

TABLE 3.—*Percentage of each species of the total small mammal population*

AREA	A		B		C		D		E		F	
Year	'47	'48	'47	'48	'47	'48	'47	'48	'47	'48	'47	'48
Condylura	—	—	1	0	1	0	—	—	—	—	—	—
Parascalops	—	—	—	—	0	3	—	—	3	0	2	11
Sorex cinereus	—	—	5	3	—	—	—	—	0	1	—	—
Sorex fumeus	22	36	14	27	25	34	15	37	7	27	4	7
Blarina	45	39	37	31	54	37	42	37	48	39	39	42
Peromyscus[1]	11	15	22	15	2	5	23	15	23	15	49	27
Clethrionomys	3	5	5	11	7	7	15	6	10	14	—	—
Pitymys	—	—	—	—	—	—	3	1	5	4	4	9
Napaeozapus[2]	19	5	16	13	11	14	2	4	4	1	3	5

[1] *P. maniculatus* and *P. leucopus*.

[2] Compiled on data taken when *Napaeozapus* was out of hibernation.

TABLE 4.—*Distribution of trap-nights*

YEAR	AREA AND TRAP-NIGHTS					
	A	B	C	D	E	F
1947	1030	904	1007	446	454	866
1948	950	978	966	784	978	709

ACCOUNTS OF SPECIES

The abundance of a species was measured as the number of individuals per 100 trap-nights. The distribution of trap-nights varied (Table 4). The data on abundance are intended to suggest relative numbers of small mammals in various habitats. Trapping in 1948 ceased after July whereas in 1947 collections were made throughout the year. One must consider this factor when contrasting the results for the two years, as the highest populations obtain in the fall. These data are more reliable for indicating increases rather than decreases, but in at least one genus a decrease is quite evident.

Parascalops breweri.—Trapping records indicate that the hairy-tailed mole comprised a permanent part of the mammal fauna in Area F. It occurred in smaller numbers in Area E. Although no specimens were trapped in the latter area in 1948, fresh tunnels testified to their presence. Two specimens were caught in Area C, but many hours of field observations in

A and B failed to reveal any evidence of the hairy-tailed mole. Although this species occurs sparingly in such habitats, it apparently is not common there. The coarse mull in Area F, and to a lesser degree in E, seems to encourage these moles. This humus is friable and offers little resistance to the burrowing of small mammals. According to Eadie (1939: 162) the food of this mole consists mostly of insect larvae and pupae and earthworms; these are forms which live in the soil. Although *Parascalops* occasionally travels above the ground at night, it is not known to what extent it feeds on these nocturnal excursions. The existence of the hairy-tailed mole might well depend upon its ability to explore new soil daily. Digging through a fibrous layer of matted mor would be far more difficult than through mull.

Condylura cristata.—Star-nosed moles were trapped adjacent to the muck in Areas B and C. The tunnels of this mole were noted in wet sections of Areas A, B, C, and F. The data (Table 3) undoubtedly show a disproportionately low number of moles of both species as contrasted with the numbers of other small mammals, but these data are useful for indicating the comparative abundance of moles in the different areas studied.

Sorex cinereus.—The cinereous shrew occurred in small numbers in Area B, and one specimen was taken in E. There is no apparent reason for its absence (or scarcity) in Areas A and C. Such small animals perhaps do not spring traps as easily as do the larger blarinas. Frequently a cinereous shrew is held in a trap only by the tail. Possibly these shrews are more widespread than the present data suggest.

In Area B *Sorex fumeus* was somewhat less common than in C and A (Table 3). This may in part account for the incidence of *cinereus* in B. There may be some interspecific intolerance between *fumeus* and *cinereus*. Dalquest (1941) explained a similar situation (involving *Sorex vagrans* and *S. trowbridgii*) as being due to competition for food. Green (1930: 11) expressed doubt that *Sorex dispar* could coexist with *fumeus*. Elton (1946) discussed the tendency of species of a genus to be distributed in a given region in different habitats. If a longer time had been spent studying this area, a change in the relative status of these two shrews might have been observed.

Sorex fumeus.—Smoky shrews were trapped in every study area, but were least numerous in E and F. In Areas A, B, C, and D they seemed to find ideal cover in the litter of the forest and beneath the leafy layers of matted mor. Although smoky shrews are inhabitants of subterranean runways, they are not diggers; and it does not seem that the nature of the humus should directly influence their local distribution. In a study of the fauna of the forest-humus layers in New York, Eaton and Chandler (1942: 23) found that in general the arthropod fauna was decidedly less in coarse mull than in matted mor. As small arthropods form the bulk of the food of this mammal, matted mor, by virtue of its greater arthropod fauna, might favor a greater abundance of smoky shrews than would coarse mull. At any rate such a suggestion seems applicable to the distribution of *S. fumeus* in the six areas of the present study.

The data indicate a population increase for *S. fumeus* from 1947 to 1948 in central New York. Five of the six areas showed an increase, and in one area (D) their numbers more than doubled. In every area they formed a relatively larger part of the small mammal fauna in 1948 than in 1947 (Table 4). The possible relationship between the populations of this shrew and *Blarina brevicauda* are mentioned in the account of the latter.

Blarina brevicauda.—Short-tailed shrews occupy many diverse habitats; and in the six wooded areas considered here they were generally the most common of all the small mammals trapped. Only once (Area F, 1947) were their numbers exceeded; at that time by *Peromyscus leucopus*. As blarinas were never observed to have been abundant in one area and scarce in another simultaneously, there is no clue to suggest any environmental feature which might affect the local distribution of this species. Ground cover such as a litter of dead leaves and leaf mold (mor) is not essential for these shrews as they were most abundant (7.6 per 100 trap-nights) in Area F which was relatively void of such cover. They were likewise abundant (6.8) in Area A where there was much litter on the ground.

The above figures represent the frequencies found in 1947, a year in which *Blarina* was very abundant in many areas in central New York. In each area they were less abundant in

1948 than in the previous year; and in all areas but one (F) they represented a smaller part of the small mammal population (Table 3).

One might suspect this apparent reduction to be the result of either the lack of fall collecting in 1948, or a reduction in the spring breeding population of 1948 caused by trapping activities in 1947. Some species, however, actually showed an increased population under the same circumstances. Although the increase of smoky shrews occurred simultaneously with the decrease of blarinas, the two changes may have been quite independent. The observations of some investigators do suggest that the two trends may be correlated. Eadie (1944, 1948) described the predation of *Blarina brevicauda* upon *Microtus pennsylvanicus*. Hamilton (1940: 488) stated that *Blarina* may be partly responsible for the reduction in numbers of *Sorex fumeus*. This being true, the converse ought to be valid: that is, a drop in numbers of *Blarina* would result in an increased population of *Sorex fumeus*.

Peromyscus maniculatus and **Peromyscus leucopus.**—The majority of *Peromyscus* taken were *leucopus*, but a few *maniculatus* occurred in the higher regions of Areas A and B. These mice were abundant in only one area (F) where they were the most numerous small mammal present (9.6) in 1947. This area is the level bottom of a ravine whereas the others are either partly or entirely "uplands." This is of interest in view of the observations of Stickel (1948: 159) who indicated that numbers of *Peromyscus leucopus* were higher in bottomlands than in uplands. This relationship, if a consistent one, would give a lead for additional studies on the habitat preference of this species. Burt (1940: 16) found that *Peromyscus leucopus* preferred rather densely wooded areas with an herbaceous undergrowth other than grass. These mice are good climbers and are often taken in traps set for flying squirrels. Possibly the vegetation plays an important part in the ecological distribution of *Peromyscus* (*leucopus* at least).

There appears to have been a decrease in numbers of *Peromyscus* from 1947 to 1948 In the absence of fall collecting for 1948 these differences may not be of sufficient magnitude to justify the assumption that a decrease actually occurred. However, in four areas (B, D, E, and F) they became a noticeably less important part of the total small mammal population (Table 4). In the other two areas this relationship remained approximately the same for the two years; in these areas (A and C) populations of *Peromyscus* were low (0.2–1.6). Evans (1942: 194) likewise observed greater reductions of *Clethrionomys glareolus* in habitats which supported higher densities.

Clethrionomys gapperi.—Red-backed voles occurred in every area except F, but they were nowhere common. This species is, for the most part, boreal in its geographic distribution; in the Ithaca region it lives in localities in company with other boreal elements. The absence of this vole from Area F and its greater numbers in E suggests that altitude might be a factor to be considered here. However, *Clethrionomys* is occasionally abundant in low-lying swamps of central New York, and it does not appear that altitude by itself is a decisive factor in its local distribution in this region.

Pitymys pinetorum.—Pine voles were taken regularly in Areas E and F. Inasmuch as the three specimens trapped in Area D were young of the year, they do not necessarily indicate the presence of a colony of *Pitymys*; quite possibly they moved from Area E which is but a quarter of a mile away. The environmental distribution of *Pitymys* closely parallels that of *Parascalops*: both live in localities where the humus is coarse mull, or where there is both mull and very deep mor. Schmidt (1931: 113) described a similar habitat for the pine vole in Wisconsin. There they occurred in hardwood forests of Colby loamy clay; the upper layer of this clay he stated to be a loamy clay well mixed with organic material (cf. description of mull). Hanson (1946: 116) correlated the habitat distribution of this vole in Wisconsin with oak forests in which there was a thick layer of leaf mold. The pelage of *Pitymys* is loose and soft, the ears are mostly hidden, and the eyes are quite small. Contrasted to *Clethrionomys*, its skull is quite flat, and the bones of the forelimbs are rather robust. These characters all reflect its underground habits. The data of this investigation suggest the physical nature of the humus as one of the most important environmental factors affecting this rodent.

Napaeozapus insignis.—Woodland jumping mice occurred in every area trapped, but were most common in A, B, and C. In three instances (A, 1947, and C, both years) *Napaeozapus* was the commonest rodent encountered. From the observations of several previous investigators it would appear that *Napaeozapus* is more numerous near watercourses. This is borne out in its distribution in the six study areas. These mice favored the cover of yew (*Taxus canadensis*) which was especially common near the borders of streams; and one runway frequently traveled by *Napaeozapus* was actually flooded most of the time. The ravines of Areas A, B, and C were well populated by this rodent whereas its numbers were fewer in D and E. Its scarcity in F must be attributed to some factor other than a watercourse for the trap sites in that area were close to the creek.

DISCUSSION

Because both living and non-living features of the environment may affect the local distribution of woodland small mammals, their habitat may be considered as being comprised of such features. Theoretically one such ecological factor could be increased so as to allow an increase in numbers of a given species. As an example, cover might be insufficient; but if cover were added to an area, a species would increase to a point at which water (or some other factor) became the limiting feature. If an animal were especially intolerant of its kind, intraspecific strife might limit its density.

The areas previously described were selected to show minor environmental differences. On each area a survey of the terrestrial small mammals was made. Attempts were made to correlate the sporadic occurrence of some of the species of mammals with certain aspects of the habitats. Obviously not all of the ecological factors have been explored. Vegetation, a conspicuous part of the habitats studied, is not treated here; the known habits of the mammals under discussion do not suggest that they depend upon any certain species of plants or any plant "associations."

The present survey, being local, may or may not supply information concerning the causes limiting the geographic ranges of these mammals. Some species, *Clethrionomys gapperi* and *Pitymys pinetorum* for example, approach the borders of their distributional patterns in central New York. Although these voles are common mammals in local woodlands, they are not inhabitants of all the woodlands of this region. With this in mind one can say that the environmental factor which confines each of these species to its habitat is the agency which limits its geographic range at this point.

Physical factors.—Exposure probably plays a role in habitat distribution of small mammals in central New York. Area D has a 30 degree northeast slope which may account in part for the high incidence of *Sorex fumeus* and *Clethrionomys gapperi* in this habitat. In Areas A, B, and C the slope is so slight that its effect is not apparent. From the situation in D one might suspect that in central New York in steep-sided ravines which run in an east-west direction the small mammal faunas of the two sides might differ.

The humus, being honeycombed at times by the tunnels of small mammals, is the most intimate part of their environment. Of course, this is more important for the more fossorial species. Of the voles *Pitymys*, more than *Clethrionomys*, is modified both externally and skeletally for a semifossorial existence. The

coarse mull favors burrowing activity, and consequently the presence of *Parascalops breweri* and *Pitymys pinetorum*. Although matted mor appears to be unfavorable to these mammals, they did occur in rather deep mor (five inches).

A possible indirect effect of humus may limit the abundance of *Sorex fumeus* by determining the availability of small arthropods for food. Covering mull (especially at the end of the summer) is not more than a scant layer of dead leaves, but mor is a many years' accumulation consisting mostly of such litter. As the latter environment supports a larger number of arthropods, which form the bulk of the food of *Sorex fumeus*, it seems that this might be partly responsible for the positive correlation of the abundance of this shrew and matted mor. That *Blarina* is not affected in this manner may be due to its somewhat more versatile food habits.

Competition between species.—The effect of one species of mammal upon another is difficult to evaluate. Most small mammals are not easily observed, and our knowledge of their ways is scanty. Analysis of their stomach contents gives information concerning the food, but sometimes little of the manner in which the small mammals obtain their food. For the most part strife and competition must be inferred from stomach analyses.

The many reports of the predatory habit of *Blarina brevicauda*, nevertheless, probably reveal some of the feeding habits of this species. Circumstantial evidence supplied by the data of this investigation points to *Blarina* as an effective agent in reducing the population of *Sorex fumeus*. In the light of the above implication and the frequent abundance of *Blarina* this shrew ought to be considered in any study of small mammal populations made in its geographic range.

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LITERATURE CITED

Burt, William Henry. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Univ. Michigan, Mus. Zool., Misc. Publ. No. 45, pp. 1–58.

Dalquest, W. W. 1941. Ecological relationships of four small mammals in western Washington. Jour. Mamm., 22: 170–173.

Eadie, W. Robert. 1939. A contribution to the biology of Parascalops breweri. Jour. Mamm., 20: 150–173.

———— 1944. The short-tailed shrew and field mouse predation. Jour. Mamm., 25: 359–364.

———— 1948. Shrew-mouse predation during low mouse abundance. Jour. Mamm., 29: 35–37.

Eaton, Theodore E., Jr., and Robert F. Chandler, Jr. 1942. The fauna of the forest-humus layers in New York. Cornell Univ. Agr. Exp. Sta., Memoir 247, pp. 1–26.

Elton, Charles. 1946. Competition and the structure of ecological communities. Jour. Anim. Ecol., 15: 54–68.

Evans, F. C. 1942. Studies of a small mammal population in Bagley Wood, Berkshire. Jour. Anim. Ecol., 11: 182–197.

GOODNIGHT, CLARENCE J., AND E. J. KOESTNER. 1942. Comparison of trapping methods in an Illinois prairie. Jour. Mamm., 23: 435–438.

GRAY, JOHN A., JR. 1943. Rodent populations in the sagebrush desert of the Yakima Valley, Washington. Jour. Mamm., 24: 191–193.

GREEN, MORRIS M. 1930. A contribution to the mammalogy of the North Mountain region of Pennsylvania. Ardmore, Pennsylvania. Privately published, pp. 1–19.

HALL, E. RAYMOND. 1946. Mammals of Nevada. Univ. California Press, pp. 1–710.

HAMILTON, W. J., JR. 1930. The food of the Soricidae. Jour. Mamm., 11: 26–39.

——— 1940. The biology of the smoky shrew (*Sorex fumeus fumeus* Miller). Zoologica, 25: 473–492.

——— 1941. The food of small forest mammals in eastern United States. Jour. Mamm., 22: 250–263.

——— 1942. Winter reduction of small mammal populations and its probable significance. Amer. Nat., 76: 216–218.

HANSON, HAROLD C. 1946. Small mammal censuses near Prairie du Sac, Wisconsin. Trans. Winsonsin Acad. Sci., Arts, and Ltrs., 36: 105–129, 1944.

HARDY, ROSS. 1945. The influence of types of soil upon the local distribution of some mammals in southwestern Utah. Ecol. Mongr., 15: 71–108.

HEIBERG, S. C., AND R. F. CHANDLER, JR. 1941. A revised nomenclature of forest humus layers for the northeastern United States. Soil Sci., 52: 87–99.

HOWE, FRANK B., H. O. BUCKLAND, AND H. G. LEWIS. 1924. Soil survey of Tompkins County, New York. U. S. D. A., Bur. Soils, Field operations of the Bureau of Soils, 1920: 1567–1622.

LIVINGSTON, BURTON E., AND FORREST SHREVE. 1921. The distribution of vegetation in the United States, as related to climatic conditions. Carnegie Inst. Washington Publ., No. 284, pp. 1–585.

MOHR. CARL O. 1943. A comparison of North American small-mammal censuses. Amer. Mid. Nat., 29: 545–587.

MORDOFF, R. A. 1934. The climate of New York State. Cornell Univ. Agr. Exp. Sta., Bull. No. 444, pp. 1–76.

SCHMIDT, F. J. W. 1931. Mammals of western Clark County, Wisconsin. Jour. Mamm., 12: 99–117.

STICKEL, LUCILLE F. 1946. The source of animals moving into a depopulated area. Jour. Mamm., 27: 301–307.

——— 1948. The trapline as a measure of small mammal populations. Jour. Wild. Mgt., 12: 153–161.

SPAETH, J. N., AND C. H. DIEBOLD. 1938. Some interrelationships between soil characteristics, water tables, soil temperature, and snow cover in the forest and adjacent open areas in southcentral New York. Cornell Univ. Agr. Exp. Sta., Memoir 213, pp. 1–76.

TAYLOR, WALTER P. 1930. Methods of determining rodent pressure on the range. Ecology, 11: 523–542.

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REPRODUCTIVE BEHAVIOR OF FOXES IN NEW YORK STATE

By William G. Sheldon

There is a surprising paucity of information on the reproductive habits of wild foxes. I have been dependent on observations made on captive silver foxes for interpretation of much of the data presented here. It is recognized that the behavior of foxes in an artificial environment may differ considerably from that of wild individuals. In *Vulpes*, the physiology of the captive animal is presumably very similar to that of wild foxes. Since *Vulpes* is probably the closest relative to *Urocyon*, the information on the latter has been treated on the same basis. It must be understood that further research may require a reinterpretation of the facts recorded here.

Much of the data was obtained from a macroscopic examination of approximately 175 female red and 90 female gray reproductive tracts from animals taken in east-central, central, and western New York from the fall of 1946 to the spring of 1948. Handling of over 100 red fox juveniles and 24 gray fox young yielded further important information.

Sex ratio.—There is a wealth of figures available on the numbers and sexes of foxes taken in New York State and elsewhere by professional trappers. It is believed, however, that these figures do not reflect the true picture. In the fall, when the majority of foxes are trapped, there is a factor of sexual selectiveness operating which invariably results in a preponderant catch of males since the latter do more traveling than the females.

Of 117 red fox foeti and juveniles sexed, 57 were males and 60 were females, a sex ratio of 95 males to 100 females. There were sixteen males and eight females in twenty-four gray fox foeti and juveniles examined. This is an insufficient number to interpret an accurate sex ratio.

Monogamy.—Seton (1929) states that both red and gray foxes are strictly monogamous, probably for life. There is question whether they are mated for life or in many cases for more than the breeding and denning season. It is probable that monogamy prevails, indicating that an unbalanced sex ratio would seriously affect the breeding potential.

I believe that occasionally one wild male may serve more than one female; there is no proof of such. Polygamy is suggested by the not uncommon instances observed of two females with separate litters occupying the same den, a condition to be discussed elsewhere.

Reproductive cycle.—Bishop (1942) found in captive silver foxes that the males contained active spermatozoa in late November, and as late as the middle of April, but that the most active breeding condition occurred from late January to the end of March. Asdell (1946) states that spermatogenesis begins in November, and the male is fertile eight to ten weeks before the breeding season begins.

No microscopic studies of testes were made in the numerous carcasses handled. All the data gathered on the condition of females suggest that a red fox male

PLATE I

Reproductive tracts of female red foxes. Left, anoestrus; right, full oestrus

may breed as early as mid-December and as late as the end of March. Gray males probably breed from mid-January to mid-May.

Female red foxes are monoestrous with a period of receptivity of from two to

four days (Asdell, 1946). Bassett and Leekley (1942) pointed out that the vulva of the silver fox increases in size and tumescence as oestrus approaches and is a fairly reliable indicator of the sexual condition of the vixen.

The vulva was destroyed in most of the carcasses examined, so efforts were concentrated on a macroscopic inspection of the internal reproductive tract. Plate I illustrates the striking difference between the horns of the uterus during anoestrus and full oestrus. During anoestrus the uterine horns are thin, varying from approximately 2 mm. to 4 mm. in diameter depending on whether the female had been previously bred. As the breeding season approaches the horns increase markedly in size and turgidity, becoming more rounded and with an approximate diameter of 7 mm. Following parturition the uterus gradually contracts, attaining normal anoestrus size after about twelve weeks. Up until the time the young are weaned, which is judged to be eight to ten weeks, placental scars in most cases are clear and well defined. If a female passes through heat and is not bred, the condition can usually be recognized, for a short time after the breeding season, by a partially contracted uterus with distinct longitudinal striations on the outside of the uterine horns, showing shrinkage, and by the lack of external signs of nursing. Placental scars may, on cursory examination, appear to be small uterine swellings in the early stages of pregnancy, but prominent striations in the cervix and horns of the uterus indicate parturition has taken place; microscopic examination can be resorted to if there is any uncertainty.

Gestation period.—Asdell (1946) gives 52 days as the gestation period for the silver fox. Based on records of 171 captive vixens, Smith (1939) gave 53 days as the average gestation, the period ranging from 51–56 days. For purposes of tabulation, 53 days has been used as the gestation period of the red fox.

Grinnell *et al.* (1937) state that the gestation period of the gray fox is not known, but is believed to be 63 days. I have assumed the gestation period to be the same as the red fox on the grounds that the rate of growth and relationship of the gray is closer to the red fox than to the domestic dog. For many years the gestation period of the red fox was assumed to be the same as the domestic dog. Further research on captive animals will provide the answer to this question.

Mating season.—Seton (1929) speaks of the mating instinct of the red fox being aroused in "late February and early March" but contradicts this elsewhere by stating that the young are born in March or early April. He gives January as the mating season for the gray fox. Asdell (1946) gives the mating season of the red fox as December to March with most matings in late January and February. February is the breeding month indicated by the same author for gray foxes. Schoonmaker (1938) records red foxes "running together" from February 12 to February 29. He witnessed a pair of gray foxes copulating on February 3 in Albany County, New York, and found evidence of grays mating elsewhere in the state on February 5 and March 9.

There is some evidence that both genera of foxes breed later in the more northern latitudes. Murie (1944) mentions a den in Alaska still occupied by pups (*Vulpes kenaiensis*) as late as September 21, long after dens have been

abandoned in more southern areas. Seton states that gray foxes are born in mid-March in the south and mid-April in the north. Hamilton (1943) mentions latitude as a factor in the gray fox breeding season. Lundberg (1932) states that *Vulpes vulpes* breeds as early as late December in southern Sweden and as late as April in the north. In this study two red fox vixens from Stratford, north central New York, had bred in late March. A gray fox foetus from West Virginia was estimated to have been conceived in the last week of February, well within the breeding season of the northern gray. Examination of four West Virginia red females indicated that three were bred in late January and one possibly as early as January 1.

TABLE 1.—*Calculated mating dates of 29 red and 19 gray foxes in central New York on the basis of foetal weights (1947 and 1948)*

		VULPES		UROCYON	
Months	Weeks	Number of Specimens	Percentage of Total	Percentage of Total	Number of Specimens
January	1				
	2				
	3	3	10.3		
	4	9	31	5	1
February	1	7	24.1		
	2	3	10.3		
	3	2	7	5	1
	4	4	14	15	3
March	1			35	7
	2			20	4
	3			10	2
	4	1	3.3		
April	1			10	2
	2				
	3				
	4				
Totals.....		29	100	100	20

Determination of foetal age.—Smith (1939) sacrificed a number of female silver foxes during the gestation period to determine the rate of growth of the foetuses. These data were used as a basis for ageing the foetuses of the gravid animals examined.

No appreciable growth begins until the fifth week, and then growth is much accelerated. There is considerable weight variation in full term foetuses. Uterine swellings are visible some days before a "weighable" foetus can be recovered. These data provide the most reliable guide in calculating breeding dates. Due to normal variation in foetal weights and gestation periods the actual day of mating cannot be accurately calculated. Table 1 gives the calculated mating dates to the nearest week. It is indicated that 76 per cent of the red foxes mated between mid-January and mid-February while 71 per cent of the grays mated

between the last week in February and mid-March. The peak of the red fox mating thus occurs at the end of January, that of gray foxes the first week in March. On the basis of the data in Table 1, mating in the red fox occurs from mid-January to the end of March, in the gray fox from late January to April. The number of gravid specimens is admittedly small. Table 2 summarizes the reproductive condition in different months, not only of the gravid animals, but of 135 additional female reds and 69 female grays. These data presumably advance the red fox breeding season to late December and extend the gray fox

TABLE 2.—*Data on reproduction of 164 female red foxes and 90 female gray foxes showing percentages and numbers*[1] *by month in condition indicated (Fall 1946–Spring 1948)*

CONDITION	NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	Red	Gray	Red	Gray	Red	Gray	Red	Gray[2]	Red	Gray	Red	Gray	Red	Gray
Non-turgid (Pl. I)	100	100	61	100	36	100		33		23		3		
	(35)	(10)	(14)	(12)	(4)	(10)	—	(1)	—	(3)	—	(1)	—	—
Semi-turgid			35		28					15		7		
	—	—	(8)	—	(3)	—	—	—	—	(2)	—	(2)	—	—
Fully turgid (Pl. I)			4		36		45	33	5	46		23		8
	—	—	(1)	—	(4)	—	(9)	(1)	(1)	(6)	—	(7)	—	(1)
Gravid							55	33	63	15	15	57	5	8
	—	—	—	—	—	—	(11)	(1)	(12)	(2)	(6)	(17)	(1)	(1)
Lactating									32		85	10	24	84
	—	—	—	—	—	—	—	—	(6)	—	(33)	(3)	(4)	(10)
Post lactation													71	
	—	—	—	—	—	—	—	—	—	—	—	—	(12)	—
Totals by month.....	35	10	23	12	11	10	20	3	19	13	39	30	17	12

[1] Figures not in parentheses represent percentages by month in each class. Figures in parentheses represent number of individuals in each class.

[2] Insufficient specimens of gray foxes to depict accurate average condition during February.

season to as late as May. In April, 15 per cent of the red foxes were still gravid and the remaining 85 per cent were lactating. In the same month 80 per cent of the gray foxes were either fully turgid or gravid and only 10 per cent were lactating. By the end of May, 71 per cent of the red foxes had weaned their pups while 84 per cent of the gray foxes were lactating. This situation is approximately what one would expect from an interpretation of Table 1 which indicates that the large majority of pregnant red foxes were due to whelp by the middle of April, and only about 10 per cent of the gray foxes were due by the same time. By May about 80 per cent of the gray foxes had whelped.

Silver fox ranchers have found that yearling pups breed on an average nine

days later than adults (Pearson and Bassett, 1946). The same may be true of wild foxes. A captive female red fox pup kept by Walter Stairs of Dryden, New York, bred on February 20, 1948, during her first year. Although 1947 and 1948 are treated jointly in this paper, because there was no significant difference in breeding dates, it is possible that a year producing a high percentage of juveniles would show a later average breeding date.

Additional data not recorded in the tables are of interest. An Ithaca fox hunter, Donald Purdy, found four red fox pups, estimated to be four weeks old, at the end of February. The vixen in this case presumably bred before mid-December. On December 14, 1947, near Ithaca, two sets of paired tracks of red foxes were observed in the snow, but there was no evidence of breeding.

It is apparent that a few gray foxes breed as late as early May. A female gray fox taken in the third week of May was fully turgid, indicating she may have been bred a week or ten days previously. Other evidence includes the examination of three gray females in late July and one in the middle of August in 1947, all of which were nursing. Moreover, many trappers have experienced catching an occasional very small gray fox as late as the end of October or early November. Examination of a female gray taken November 10 had an estimated weight of six pounds. A captive gray male weighed seven pounds at an estimated age of four months.

Circumstantial evidence suggests that at least some gray females do not breed until their second year. Two reports of reliable trappers are worthy of note. In the spring of 1946 George Hughes trapped fourteen female red foxes and sixteen female grays between May 1 and June 30. According to Hughes, all the red foxes had whelped, while all the grays were barren except a nursing individual taken on June 27. In the spring of 1948 William Mosensteen reported catching seven barren female grays in May. Examination of one indicated that it had not bred. It is possible that some of the grays could have been in the earlier stages of pregnancy, but most experienced trappers can recognize a pregnant female after the foetus is five weeks old, and lactation signs are unmistakable for at least twelve weeks after parturition.

Further evidence that some gray fox females do not breed as yearlings has been recorded by Taylor (1943). He observed that two male and three female captive pups showed no signs of sexual activity during their first year.

Barren females.—Of 172 female red foxes studied, eight were definitely barren, and of 90 gray foxes, three barren individuals were found. It appears probable that the percentage of unbred females in both genera is actually higher, since the only ones which could be definitely classed as barren were those examined after the breeding season in the late spring. At this time no uterine turgidity or signs of lactation were evident.

Lactation.—Five weeks after a fruitful mating, unmistakable external indications of pregnancy appear in both genera, a condition which becomes more pronounced up to and for several weeks following parturition. With the approach of partus, the usual dirty white hair in the mammary region of the red fox becomes thin and is replaced by characteristic rufous hair, a condition which per-

sists even after weaning. Most of the red vixens have eight mammary glands. Gray vixens lose much of their hair in the mammary region before and for some weeks after parturition. Gray foxes normally have six functional mammae.

Life span.—Although ranch foxes have attained fifteen years of age, it is likely that wild individuals seldom reach ten years. Of eighty-two red fox skulls examined, 8.5 per cent were classed as well past middle age, judging by the wear on the dentition. By the same criterion 30.8 per cent of twenty-six gray fox skulls examined were old individuals. The great majority of animals were in their prime; it is possible that due to their more seclusive habits a larger percentage of grays will survive until old age.

Litter size.—Seton (1929) states that the red fox has four to nine pups in a litter, while the gray fox has three to five young. Hamilton (1943: 172) records four to ten young for the red fox. Cory (1912: 301) gives four to six for gray fox litter size. Asdell (1946) reports one to eight young in silver fox litters, while other fur farm investigators give one to nine as the litter size range.

Davis and Emlen (1948) believed that placental scars are a poor indication of litter size in the domestic rat. However, in a monoestrous carnivore such as the fox fresh placental scar counts are considered accurate enough to be included in the calculation of average litter size. No uteri were included in the figures below unless the placental scars were fresh and clearly discernible. Litter counts of young red foxes were found to be a less accurate method than the counting of embryos and placental scars. This is due to certain denning habits of the red fox to be discussed elsewhere. Ninety-five red females showed an average litter size of 5.37 (1–9). Thirty-five gray vixens averaged 3.66 offspring (1–7). The actual average at birth is probably somewhat below this since no allowance is made for abortion or resorption of embryos. Based on the foregoing information the breeding potential of the red fox is approximately 2.5 per adult and of the gray fox 1.5 per adult.

Red fox care of young.—According to Westell (1910), the male European red fox (*Vulpes vulpes*) is primarily responsible for clearing the den and is most active in securing food for the nursing vixen. Seton (1929) credits the male with bringing in most of the food before the pups are weaned.

A large number of nursing females, caught by state trappers in New York in early April, were taken well removed from the den sites. Many showed evidence of recent parturition. This suggests that the vixen commences to hunt shortly after partus. It is possible that the female hunts during the night and nurses the pups during the day.

Vixens only were observed at many occupied dens, but both parents were often seen at other dens. Most observers assume that any single adult fox seen with pups is the vixen, but in several instances the male was observed alone with the pups. One can often recognize a vixen from some distance by observing the weaned pups making abortive attempts to nurse.

On the evening of May 3, 1947, a white mouse was tossed into a plowed field about 100 yards from an occupied den. At the time, both adult foxes and young approximately six weeks old were observed about the den entrance. The adult

male first started to forage; he quickly found the mouse and carried it to the pups. The male seemed to take as much delight as the vixen in playing with the pups. A few minutes before dark both parent foxes commenced to hunt, leaving the pups playing by themselves.

On the evening of June 12, 1947, a well-grown litter was observed. The vixen first appeared and investigated three groups of den holes in an open pasture. These were separated by about 100 yards. She was soon joined by two pups. For a few moments she lay down on the most prominent knoll in the field, then arose and, followed by the pups, passed under a fence into a plowed field. The male parent then appeared and followed almost exactly the route of the family; it lay down for a few moments on the same knoll. The pups remained with the mother. As darkness approached, the dog fox began hunting in the field and woods nearby.

At the many dens observed the curiosity of the pups usually overcame any fear they possessed and the mother's warning bark was often ignored. On June 13, 1947, a litter of four well-grown pups playing in front of a den in the deep woods were being observed from a distance of 75 yards; they were shortly joined by the vixen who soon left and headed directly for me, unaware of my presence. She approached within ten feet before seeing me, whereupon she dashed to the top of a ridge 100 yards from the den and barked excitedly. The pups did not take immediate alarm so I approached closer. Three of the pups then went in the hole, but the fourth allowed an approach to within 50 feet. Suddenly the vixen appeared, dashed behind the pup, growled and nudged him down the hole; scarcely breaking her stride, she ran within 15 feet of me and back to the ridge top. This demonstrated her fearlessness and her inability to drive the pup to ground by barking from a distance.

Normally the male is more wary than the vixen, but not nearly as fearless when the pups are endangered. There unquestionably are many differences in behavior between individual foxes; this was notable in the different vixens observed at several dens. Some acted much wilder than others.

Scott (1943) observed that, after leaving the den, fox families stay together until dispersal in the fall. This study supported the same observation, but there was no way of determining definitely if the male adult remained an integral part of the family. As a general observation, it was noted that the younger and more helpless the pups the more concerned were both parents in their welfare.

The tendency of the vixen to move her pups to different dens when disturbed is too well known to merit a full discussion. One record gained through tagging young foxes in the spring of 1948 will suffice. At least five pups judged to be approximately eight weeks old were moved on May 8 from a den in an open field to a wooded den a mile distant. A week later they were moved to an open field den half a mile away, but were not found after a fourth move.

Errington and Berry (1937) have posed the question of how long young foxes are dependent on their parents for survival. The present study suggests that so far as food is concerned the young are certainly able to care for themselves after they lose their lacteal dentition at about sixteen weeks of age. A vixen pup kept

in captivity for eight weeks and released two miles from her den site on August 1, 1947, was killed in good health the following October 20. Undoubtedly the adults offer protection against dogs, although all pup foxes seem to instinctively seek a burrow when danger threatens.

It seems to be generally accepted that parent foxes teach the young how to hunt. This is probably true, since half-grown pups were observed accompanying and watching their mother hunting mice. That parental instruction is not always necessary was evidenced by the instance of a young male gray fox kept in captivity from an estimated age of six weeks until almost full growth was attained on October 1, 1947, when he was released. This animal, in good health, was killed the following July; it had survived an unusually severe winter. Errington and Berry (1937) present evidence that captive red foxes released in the early fall stand a better chance of survival than those released in the spring at some distance from their home dens.

Gray fox care of young.—Records of two direct observations show the gray fox vixen as a bolder mother than the red. In one instance during May, 1947, three pups were playing outside the den; as Mrs. C. Fish of Ithaca approached within thirty yards the mother stood her ground, growling and baring her teeth. The vixen started in the direction of the observer, whereupon the latter retreated, fearing the fox was rabid. H. E. Evans observed three gray pups at play, accompanied by their mother, in May, 1947. The latter growled and did not retreat until Evans approached within about fifty feet.

Growth of young.—Captive silver fox pups weigh approximately one pound six ounces at four weeks of age, three pounds eight ounces at eight weeks and five pounds ten ounces at twelve weeks (Smith, 1928). Ranch foxes attain full growth in twenty-five weeks (Smith, 1935). Examination of embryos indicated that at birth young wild red and gray foxes average about 100 grams. There was found to be a pronounced difference in the weight of the sexes from the time of birth. Until the thirteenth week the males weigh appreciably more than female litter mates.

According to Seton (1929) young red foxes open their eyes about eight days after birth and come to the surface of the den when approximately four weeks old.

The smallest wild red foxes weighed in this study were from a litter (collected April 21, 1948) averaging about one pound and ten ounces, and estimated to be four weeks old. They were still very dark in color; their coats were woolly with no guard hairs and their tails were very small. Their stomachs contained some scraps of woodchuck skin which their parents may have torn off for them. Pups estimated to be six weeks old were capable of swallowing mice entire.

A captive red vixen pup weighing two and a half pounds on May 1, 1947, at an estimated age of six weeks, weighed seven pounds in early August. At this time its coat was scrubby and thin and its permanent dentition was not fully developed. Lacteal dentition began to be replaced July 12 at sixteen weeks of age, and was completely replaced in two weeks.

By the middle of September most red fox pups have attained practically full

growth and can be distinguished from adults only by the appearance of their coats. At this season, juveniles have glossy and immaculate pelts whereas the summer coats of old foxes are not yet fully replaced by the winter pelage. Through October the white belly fur of pups is normally dirtier and grayer than that of adult animals. This was evident from banded pups recaptured in October.

One gray fox pup found on a highway and estimated to be four weeks old was woolly in appearance with a few guard hairs. Pups of a gray fox litter estimated to be six weeks old were fully clothed in guard hairs with a pelage similar in color and appearance to adults. A captive gray male pup showed almost exactly the same rate of growth as a red vixen pup estimated to be two weeks older. By August 12, 1947, the gray weighed seven pounds; when recaptured the following July 8 it weighed nine pounds.

Males of both genera probably increase in weight for the first two or three years, since the heaviest specimens showed considerable tooth wear.

SUMMARY

1. A macroscopic examination of reproductive tracts from 175 female red and 90 female gray foxes, taken in New York State, provided most of the reproductive data recorded.

2. One hundred and seventeen red fox foetuses and juveniles gave a sex ratio of 95 males to 100 females.

3. Monogamy prevails, but the frequent occurrence of more than one litter in a den suggests possible polygamy.

4. Red foxes breed from mid-December to late March; the majority mate in late January and early February.

5. Gray foxes breed from mid-January to May; the highest percentage mate in early March.

6. Circumstantial evidence suggests that some gray fox females do not breed until their second year.

7. On the basis of recent placental scar counts as well as embryo counts, 95 red females showed an average litter size of 5.37 (1–9). Thirty-five gray vixens averaged 3.66 (1–7) offspring.

8. Adult males were not observed at all occupied dens; they were found to be more wary than the vixens and not as bold when pups were endangered.

9. There is evidence that the vixen starts hunting at night shortly after the pups are born.

10. A captive female red fox pup and a male gray fox pup showed a parallel rate of growth.

11. Observation indicated that red fox pups are weaned at eight to ten weeks of age when they weigh about three and a half pounds.

12. Lacteal dentition is replaced when the pups are three-fourths grown at approximately sixteen weeks old.

13. Foxes approach full growth at twenty-five weeks.

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LITERATURE CITED

ASDELL, S. A. 1946. Patterns of mammalian reproduction. Comstock Publishing Co., pp. 1–437.

BASSETT, C. F., AND J. R. LEEKLEY. 1942. Determination of estrum in the fox vixen. North Amer. Veterinarian, 23: 454–457.

BISHOP, D. W. 1912. Germ cell studies in the male fox, *Vulpes fulva*. Anat. Rec., 84: 99–106.

CORY, C. B. 1912. The mammals of Illinois and Wisconsin. Field Mus. Nat. Hist. Zool., ser. 11. pp. 1–502.

DAVIS, DAVID E., AND JOHN T. EMLEN, JR. 1948. The placental scar as a measure of fertility in rats. Jour. Wildlife Mgt., 12: 162–166.

ERRINGTON, PAUL L., AND R. M. BERRY. 1937. Tagging studies of red foxes. Jour. Mamm., 18: 203–205.

GRINNELL, JOSEPH, JOSEPH S. DIXON, AND JEAN M. LINSDALE. 1937. Fur-bearing mammals of California. Univ. Calif. Press., vol. 2, pp. 377–777.

HAMILTON, W. J., JR. 1943. The mammals of eastern United States. Comstock Publishing Co., pp. 1–432.

LUNDBERG, GUSTAF. 1932. Vart villebrad; Raven. Skogen; Nr., 6: 133–136.

MURIE, ADOLPH. 1944. The wolves of Mount McKinley. U. S. Dept of the Interior. Fauna series No. 5, pp. 1–257.

PEARSON, OLIVER P., AND CHARLES F. BASSETT. 1946. Certain aspects of reproduction in a herd of silver foxes. Amer. Nat., 80: 45–67.

SCHOONMAKER, W. J. 1938. Notes on mating and breeding habits of foxes in New York State. Jour. Mamm., 19: 375–376.

SCOTT, THOS. G. 1943. Some food coactions of the Northern Plains red fox. Ecological Monographs, 13: 427–479.

SETON, E. T. 1929. Lives of game animals. Doubleday, Doran and Co., vol. 1, Part II: pp. 340–640.

SMITH, G. ENNIS. 1928. Report of Supt. of Experimental Fox Ranch, Summerside, P. E. I.; Dept of Agr., Dominion of Canada (for 1926 and 1927), pp. 1–59.

——— 1935. Report of Supt. of Experimental Fox Ranch, Summerside, P. E. I.; Dept. of Agr., Dominion of Canada (for 1931–1934), pp. 1–57.

——— 1939. Growth of fox foetus and length of gestation period. Can. Silver Fox and Fur, March.

TAYLOR, WALTER P. 1943. The grey fox in captivity. Texas Game and Fish, Austin, 1(10): 12–13, 19.

WESTELL, W. PERCIVAL. 1910. The book of the animal kingdom. London: J. M. Dent and Sons, Ltd.: pp. 1–379.

French Hall, Univ. of Mass., Amherst, Mass. Received October 4, 1948.

ECOLOGICAL AND LIFE HISTORY NOTES ON THE PORCUPINE IN THE ADIRONDACKS

By Jacob Shapiro

In 1946–47 a study of the porcupine (*Erethizon d. dorsatum*) was conducted on the Anna and Archer Huntington Wildlife Experiment Station (hereafter called Experiment Station), Newcomb, New York. The purpose of the study was to observe the ecological relationships of the porcupine with the forest. The Station forest is nearly rectangular in outline and consists of 14,984.2 acres of which 1,459.2 acres are water area. Its altitude ranges from 1,560 to 2,693 feet with an average elevation of about 2,000 feet. The study area is approximately one-third of the tract or 4,062.7 acres. Most of the common types of the Adirondack forest habitats are found within its boundaries and by vegetative quadrat sampling they were found to be representative of the central Adirondack region.

The field work for the study occupied three days a week from May 1 to September 1, 1946, and seven days a week from February 15 to April 1, 1947. Many of the known authorities on the subject were consulted for verification of data and for suggestions through the state. I wish to express appreciation to Professor R. T. King, Director of the Roosevelt Wildlife Forest Experiment Station, and to the following members of the staff: Professor W. A. Dence and Mr. F. B. Barick, the latter now a member of the Pennsylvania Conservation Department, for suggestions throughout the investigation and for the critical reading of the original manuscript. Special thanks are due Dr. P. H. Struthers of Syracuse University, Dr. D. A. Spencer of the U. S. Fish and Wildlife Service, Dr. J. D. Curtis of the Intermountain Forest and Range Experiment Station, Dr. Albert Shadle, University of Buffalo, and Dr. W. A. Jellison of the Rocky Mountain Public Health Service Laboratory. I am also grateful to the many others who contributed to the original thesis.

Sixteen porcupines, seven males and nine females, were handled during the course of this study. Five were classed as immature on the basis of weight and three of the five adult females were pregnant. Sixteen active dens located at wide intervals were under observation during the winter. Four active dens located in the southern half and about one mile from each other were checked three times weekly during March for deer-porcupine relationships. Each of over sixty dens found during the summer contained some evidence of occupancy, such as scat and quills, but no animals were observed in them during the following winter.

The porcupine has been able to maintain its range in the northeast despite man's encroachment on its habitat. Recently its range has been extended into western Connecticut (Goodwin, 1932), but, in general, its nationwide range is shrinking. The following excerpts from questionnaires sent to state comissioners in 1946 confirm this conclusion. N. R. Barger (1946) stated that "The range of the porcupine in Wisconsin today is not well known . . . however, it is our opinion that the range has shrunk slightly northward." J. R. Harlan (1946) stated that in Iowa ". . . probably . . . in the earlier days the species occurred

sparingly in the northern, and particularly in the northeastern part of the state." W. B. Barnes (1946) stated that "Canada porcupine are not found in Indiana. In the early history of Indiana, it was reported but never in great numbers." F. B. Chapman (1946) stated that "Although the porcupine was at one time common in northern Ohio, it is probably now extirpated in the state. . . . Porcupines . . . are still of sporadic occurrence along the Pennsylvania boundary." W. R. DeGarmo (1946) stated that "No porcupine now exists within the boundaries of West Virginia. The last previous record of porcupine taken in the state was about 1917." C. P. Patton (1946) stated that "It is questionable whether or not Virginia has ever been included within the range of the porcupine . . . it does not occur this far south in the present day. . . . In 1739 there were two porcupines killed here . . . there is little doubt, however, that it did once occur in Virginia since its remains have been found as far south as Tennessee." L. G. MacNamara (1946) stated that "The porcupine is very rare in New Jersey. The only records of the animal are that one was killed . . . about twelve years ago, one . . . about three years ago, and one . . . this year."

One of the many peculiarities of the porcupine is its scent. The animals were not found to establish scent posts, but all feeding trees observed during the winter showed evidence of frequent urinations at the base. Urine in the runways is common and especially noticeable at the den entrances. The odor of the porcupine, being similar to that of the urine, may arise from its unsanitary habits rather than from scent or sebaceous glands.

In examining the teeth and bone sutures for age criteria it was found that the last molar teeth were not erupted in the one summer-young examined. The three molars of the adult were evident in each of the ten skulls examined. It is probable that the porcupine like many other rodents grows slowly throughout life. The seven males examined averaged 12.9 pounds and nine females averaged 10.1 pounds with a general average of 11.5 pounds. The weights for the individual animals were as follows: Males, 23.5, 20.0, 13.5, 10.0, 9.5, 8.6, 6.0 pounds; Females, 14.7 (pregnant), 13.5, 13.0 (pregnant), 10.0, 9.9 (pregnant), 9.9, 6.3, 6.0, 5.0 pounds.

Many outdoorsmen believe that the porcupine will not leave a tree if hindered by an obstacle. In three instances, when porcupines were located in trees, platforms were built around the trunks at varying heights from the ground. In none of these instances did the platform prevent their escape. Loose quills were found on the ground directly under the platforms of the first and second trees, indicating that the animals must have fallen in their efforts to circumvent the obstacle. In the third tree the porcupine probably transferred himself to an adjoining tree by clinging to touching branches.

The porcupine was not observed to be truculent in the wild or in captivity. Two males and one female were held in a small cage during the first half of September with no ill effects. One immature female, examined in March 1947, had five quills embedded in the external fascia covering the right hip, perhaps intraspecific strife is not wholly absent. The animal did not appear to be suffering from the effects for it was in excellent physical condition when killed.

During the study two fetuses were examined. The first, a female, was obtained from a 14.7-pound female on March 21. Measurements, in inches, were: total length (tip of nose to last tail vertebra), 7.7; tail length, 2.6; foot length (left), 1.0; weight, 13.6 ounces. The fetus was near term since it was fully covered with black hair and its incisor teeth were prominent. No quills were discernible. The second fetus, a male, was removed from a 9.9-pound female on April 14. It measured: total length, 11.0; tail length, 2.4; foot length (left), 1.2; weight, 9.28 ounces. This fetus was at a similar stage of development as that recorded for the other. Curtis and Kozicky (1944) stated that all mature females may not become pregnant. It was found in this study that even those that do become pregnant may not produce living young. On two occasions the writer observed evidence of abortion. The first specimen was sent to Dr. A. Shadle of the University of Buffalo for analysis and the second case was determined by physical comparison with the previous one.

Little has been mentioned about the den of the porcupine, particularly in winter. Gabrielson (1928) stated that the dens in Oregon were almost invariably sheltered by large blocks of rocks which rendered them warm and dry during the winter months. Dryness does not appear to be an important factor in den choice in the Adirondacks, as three dens on the shores of lakes and near swamps were not particularly dry. It is my opinion that the dens serve primarily as a protection from the wind and snow and possibly from predators, but are not selected for protection against the cold. The fact that the coldest temperatures occur during the night when the porcupines are usually away from the dens further indicates that warmth is not the important factor in the use of dens. The dens found exhibited no marked exposure preference. The porcupines inhabiting 75 per cent of the dens used temporary shelters as supplements. These auxillary dens were twenty feet to more than one-half mile away. One animal, under a month's intermittent observation, did not appear to have a den, but rested during the day in the same tree in which it had been feeding during the night.

All the occupied den sites showed evidence of former use. Many recently occupied but vacant sites might have been used by transients or by pregnant females during spring. No denning colonies were found. The use of a den by more than one occupant was observed, but in no instance was more than one porcupine found in a den.

The notes of previous workers on the Experiment Station and the available literature indicate that the porcupine is not a selective feeder during the summer. During the winter the animal shows a marked order of preference. The preferred foods listed in Table 1 are based on tabulations of trees fed on in four denning sites and on tallies of porcupine damaged trees made during a five per cent cruise. The "Per cent of Species" is determined from a complete count of all trees within a 75-foot radius of each of four active dens in four different forest types. The "Abundance Rating on Study-area" is based on Webb's (1942) method. An anomaly was found in one instance where a broken beech limb was observed wedged in the crown of an adjoining hemlock tree. The particular hemlock was a feeding tree, but the porcupine had completely stripped the bark

from the beech limb in preference to the surrounding easily accessible hemlock foliage.

The porcupine ordinarily does not eat both foliage and bark of the same species, usually, it prefers one to the other. Hemlock, however, seems to be an exception, for in many instances the bark of the smaller limbs as well as the foliage is eaten. Although Curtis (1941) stated that only the previous year's growth of coniferous foliage is eaten, in this study twigs of hemlock collected under several trees showed that more than the previous year's growth was being consumed.

Wild animals in general usually do not seek open water when snow is present. However, in one instance a porcupine had constructed a well-beaten runway to an open pool about fifty-five feet from its den. Another porcupine occupying a den located approximately the same distance from a similar open pool did not make any attempt to visit the water during the period of this investigation. Thus water requirements during winter may be based on individual differences.

TABLE 1.—*Winter food preferences of the porcupine in decreasing order of importance*

SPECIES	PER CENT OF SPECIES	ABUNDANCE RATING ON STUDY AREA
Hemlock	78	5
Red Spruce	25	1
Sugar Maple	13	4
Yellow Birch	11	2
Striped Maple	10	7
Beech	7	3
Balsam Fir	5	6

Food requirements and consumption have not been adequately studied for the eastern porcupine. A pregnant female was held in captivity during March in order to determine its food consumption. She was fed on fresh cut hemlock branches and consumption was determined by the difference in the weight of branches given and removed. Since the branches in some cases contained ice or snow and in addition there was loss from drying out, the results actually were only approximations. A total of 29 pounds 8 ounces was consumed during the study period. The average amount of food consumed per day for the period of 32 days was 14.75 ounces. The animal survived over this period with no apparent hardships, appeared in excellent health and was immediately responsive to any annoyance. Feeding and exercising took place during the night while during the day the animal generally remained quiescent in a "hunched over" position in a corner of the pen. Because of the error in weight determination as previously mentioned and the restriction of the animal in a pen in an unheated barn the results obtained are only approximations; however, they provide an indication of the basic metabolism of the porcupine.

The porcupine is seldom seen during the summer, because of dense foliage, and rarely in winter because of its diurnal denning; however, its pellets are omnipresent. The characteristic brown color and crescent shape needs little descrip-

tion. The pellets in many cases are enclosed in a membranous sheath resembling sausage links. Taylor (1935) mentioned 75 pellets as the average number evacuated per day. This study indicated that the average is closer to 180 for this region. Scats were collected from a porcupine which fed in a hemlock for five consecutive days. It was possible to collect all pellets dropped during this period because of the packed snow, good visibility, and no disturbance by other animals. This porcupine dropped 831 pellets, a daily average of 166. A captive animal dropped 3,245 pellets over a period of 16 days, an average of 203 per day. The number of pellets dropped per evacuation was computed on the basis of internal intestinal counts and fresh dropping counts and was found to vary from 45 to 75. It is believed that the animal voids three times a day, deduced from observing the amount of ice formed around the pellets and their positions in the snow from day to day.

Nineteen hundred pellets weighed 1.9 pounds (average .016 ounce each) which gives an average of 3.25 ounces evacuated per day. The food ingested by a captive pregnant porcupine averaged 14.75 ounces per day and approximately 22 per cent of it was eliminated as waste.

Spring and fall migrations have been recorded by Taylor (1935) and Struthers (1928). Spencer (1946) mentions certain drifts. Migrations on the study area were very gradual if they occurred at all. The interspersion of both summer and winter foods may be responsible for this condition. Many tracks and some animals were observed crossing the various tote roads and highways during early spring. However, this activity was localized and was not believed to be an exodus to a new region. No travelways such as described by Taylor (1935) were observed.

The summer range of the porcupine was not determined since none of the animals tagged (5 in all) were recaptured. The winter cruising radius was determined by measuring the feeding runs. These runs extended from 26 to 3190 feet with an average of 430 feet. This gives an approximate feeding area of 13.3 acres during the winter season.

It was possible during the study to initiate a superficial investigation of the cestode fauna found in the duodenal region of the small intestine. Three animals were examined. The helminth fauna consisted of two species, namely: *Shizotaenia erethizontis* and *Shizotaenia laticephala*. The former numbered 37, 13, and 17, respectively, whereas the latter numbered 284, 185, and 148. The first porcupine (3G) contained 321 worms with a ratio of one *S. erethizontis* to eight *S. laticephala*. The second porcupine (12G) contained 198 with a ratio of one to fourteen and the third (17G) contained 165 with a ratio of one to nine. The *S. erethizontis* was found to be the least abundant, being found only one tenth as frequently as *S. laticephala*.

The variance between these data and those of Jellison (1933), who reported 144 *Schizotaenia erethizontis* and 358 *Schizotaenia laticephala*, and of Curtis and Kozicky (1944), who found an average of 766 for the tapeworm population, suggests that the above samples either are not adequate or that areas differ in their incidence of infestation.

The censuses of porcupines have been haphazardly taken at best. Most censuses have been estimates taken in conjunction with some other project such as timber cruising, or have been intensively taken over a relatively small portion of a range where the animal is concentrated. The populations recorded from the various methods employed in different sections of the country range from one porcupine per 11 acres to one per 213 acres. The number of porcupines present on the study area as determined by the line strip method (5 per cent cruise) was 78 or one per 52 acres. Several other methods of census taking were investigated. These were: summer den and winter occupance correlation, pellet

TABLE 2.—*Location, age, and type of damage inflicted on trees by porcupines on the check area*

SPECIES	NUMBER OF TREES								NUMBER OF STEMS	AVERAGE D.B.H. (INCHES)	LOCATION OF DAMAGE		
	Old[1] Damage	New[1] Damage	Girdled[2]	Clipped[2]	Light Damage[3]	Moderate[3] Damage	Heavy Damage[3]	Complete[3] Damage			Base	Middle	Top
Hardwoods													
Beech	360	40	360	0	106	88	166	20	360	8.3	140	100	100
Sugar Maple	320	60	320	0	20	100	240	100	360	7.5	80	40	140
Yellow Birch	240	0	240	0	20	60	160	40	240	6.1	40	100	60
Softwoods													
Hemlock	780	180	80	820	220	240	400	40	960	7.8	40	60	720
Spruce	780	260	1000	20	100	400	520	100	1020	6.2	360	440	120
Cedar	60	40	0	60	0	0	60	0	60	7.7	0	0	60
Balsam Fir	0	20	0	20	0	20	0	0	20	13.0	0	0	20
Aspen	20	0	20	0	0	20	0	0	20	7.0	0	20	0
Total	2560	600	2020	920	466	928	1546	300	2940	7.95	660	760	1220

[1] Tree may have both recent and old damage recorded on it.
[2] Tree may have both clipped and girdled work recorded on it.
[3] More than two thirds of stem or crown damaged.

count, early spring count in aspen stands, and roadside count. None of these gave adequate results. Probably the best census method described to date is that given by Curtis (1944), but because of the man power required and the expense involved it is prohibitive on extensive areas.

The economic and ecological effects of the porcupine on the forest have been, in most instances, either underestimated or exaggerated. A part of this study consisted of a quantitative appraisal of these effects. The data are summarized in Tables 2, 3, 4, and 5. The data were obtained by a 5 per cent cruise and a study of damaged trees within a 75-foot radius of four occupied dens from four different areas through the use of a method patterned after the one described by Curtis (1941). All damaged trees were thoroughly examined to determine

accurately the destructive agent. The damage was recorded as slight, moderate, or serious. During the calculations, all damaged trees were considered as a

TABLE 3.—*Porcupine damage to the merchantable timber on the check area, based on a five per cent cruise*

SPECIES	NUMBER OF STEMS (EACH)	D.B.H. (INCHES)	EST. HEIGHT RANGE (FEET)	TOTAL VOLUME[1] DAMAGED (B.F.)	VOLUME[1] OF DAMAGED PER ACRE (B.F.)	TOTAL VALUE[2] (DOLLARS)	VALUE PER ACRE (DOLLARS)
Hardwoods							
Beech	120	11–22	45–70	27382.60	6.74	273.82	0.07
Sugar Maple	100	9–20	35–80	27707.61	6.82	277.07	0.07
Yellow Birch	40	12–14	55–60	3319.62	.817	33.19	0.01
Total	260			58409.83	14.37	584.09	
Softwoods							
Hemlock	520	8–16	40–100	55821.50	13.74	558.21	0.14
Spruce	260	8–16	40–80	25879.40	6.37	258.79	0.06
Cedar	60	7–9	35–50	1348.81	.332	13.48	0.003
Balsam Fir	20	13	60	1385.38	.341	13.85	0.003
Total	860			84435.09	20.78	844.35	
Grand Total	1120			142844.92	35.160	1428.44	

[1] Volumes computed from Foresters' Tables for New York (Belyea, 1933).
[2] Value based on $10.00 per thousand board feet stumpage value.

TABLE 4.—*Analysis of damaged trees by forest types on the check area*

FOREST TYPES	AREA (ACRES)	PER CENT OF TOTAL AREA	NUMBER OF STEMS		VOLUME OF DAMAGED TREES			LOSS PER ACRE (DOLLARS)
			Non-commercial	Commercial	Total volume (b.f.)	Volume per Acre (b.f.)	Per Cent of Total	
Hardwoods	1539.6	37.89	840	320	51722	34	37	0.34
Mixed Hardwoods	1302.0	32.04	320	520	68660	53	48	0.53
Lower Spruce Slope	144.9	23.21	420	100	11592	80	8	0.80
Spruce Flat	943.2	3.57	240	180	10870	12	7	0.11
Spruce Swamp	119.1	2.93	—	—	—	—	—	—
Beaver Ponds	13.9	.34	—	—	—	—	—	—
Total	4062.7	99.98	1820	1120	142844	35		0.35

total loss therefore the figures obviously are exaggerated. The damage to the forest has seldom been computed on the basis of the stand, the work of Curtis (1944) being the exception.

Any size tree may be attacked, but the range preference was from two to ten inches d.b.h. The trees recently attacked were usually fast growing and thrifty.

No current damage was noted on an old tree unless it had been attacked previously. Fortunately the animal has a strong predilection for returning year after year to the same trees. It was found that the assault on the bark of intermediate size stems is more likely to be a continuation of the previous damage, whereas the only trees of commercial size attacked are those which had been previously damaged and the attack may be either around the periphery of a previous scar or in a new location. The greatest number of trees revisited occurred in the mixed hardwood type and the least in spruce flat type.

The total volume of damaged timber on the study area was calculated to be 142,844 board feet or 35.16 board feet per acre. At current stumpage prices this would amount to a total of $1,428.44 or $0.35 per acre. Thus the porcupine-damaged timber of commercial size constitutes a loss of about 0.7 per cent of the

TABLE 5.—*Comparison of old, current, and recurrent porcupine damage on the merchantable trees on the check area*

SPECIES	TREES CURRENTLY DAMAGED			TREES PREVIOUSLY DAMAGED		TREES RECURRENTLY DAMAGED		TREES WITH ALL AGES OF DAMAGE COMBINED TO GIVE TOTAL DAMAGE TO SPECIES	
	Volume (b.f.)	Value (Dollars)	Per cent of Total Damage to Species	Volume (b.f.)	Per Cent of Total Damage to Species	Volume (b.f.)	Per Cent of Total Damage to Species	Volume (b.f.)	Value (Dollars)
Beech	7000	70.00	25	20382	74	2860	10.4	27382	273.82
Sugar Maple	7020	70.20	25	20687	75	23180	84	27707	277.07
Yellow Birch	—	—	—	3319	—	2120	64	3319	33.19
Spruce	3600	36.00	14	22279	86	140	5	25879	258.79
Hemlock	12280	122.80	22	43541	78	26600	48	55821	558.21
Cedar	—	—	—	1348	100	—	—	1348	13.48
Balsam Fir	—	—	—	1385	100	—	—	1385	13.85
Total & Averages	29900	299.00	21	112941	79	54900	38	142844	1428.41

total volume. This damage is made up of about 65 per cent conifers and 35 per cent hardwoods. The damaged conifers are almost four times as abundant as hardwoods, yet comprise less than twice the volume because of the many small trees included. However, the loss in hardwoods is more immediate because the trees usually were killed.

It has been stated (Taylor, 1935; Curtis, 1941; Reeks, 1942) that scientific management of a forest largely would eliminate any porcupine problem. Some of the silvicultural methods that may be employed are: insuring ample seeding to compensate for loss, leaving "worked" trees for buffers, and encouraging predators by permitting suitable cover to exist when it does not affect the final timber crop.

Other values than commercial have been attributed to the porcupine. The one receiving the most attention is that of porcupine clippings and deer food during heavy snow. This relationship was investigated by means of collecting twig droppings for a month and correlating these with deer activity in the

immediate vicinity. Weights and numbers both were approximations for two reasons: 1) it was impossible to shake the ice from the needles on cold days, whereas the branches were free from ice and snow on warmer days, 2) short branchlets under two inches were neglected because of the difficulty in handling. Correlating the value of the clippings for deer food also was approximate as the previous year's growth is preferred by the deer as well as the porcupine and the twigs collected in many instances were of little food value for the deer. Thus the weight as determined from the total clippings did not indicate total food available. After being weighed, the twigs were removed from the feeding area and piled at one side. The snow under each tree was packed down by snowshoe tramping, and deer tracks were obliterated by combing with a branch.

Porcupine feeding could be distinguished from deer feeding on the fallen branches by the nature of the bite. The porcupine makes a clean incision of the branch usually at a slant and the needles are nipped off by distinctive bites, with the basal portions generally remaining on the twig. The deer usually strips a branch of needles, seldom takes the bark off, and very rarely makes a clean incision at the end or base of the twig.

Deer activity in the various feeding areas was not consistent. In one area deer would pass by a stacked pile of hemlock boughs and browse on the twigs scattered under a tree; whereas in another area the pile would be stripped of needles and the uncollected branches under the tree ignored. The larger twigs fed on by deer usually were tramped into the snow as if the animal had attempted to hold them down with one foot while stripping them of foliage. There did not appear to be any pattern of selectivity as the deer ate the smaller twigs as often as the larger ones.

It was evident throughout the study that porcupine clippings were a decided attraction, for deer tracks led to all porcupine feeding areas at one time or another. The value derived by the deer from these clippings cannot be accurately determined from a single winter's study. The 1946–47 season was characterized by an abundance of food and the deer were able to support themselves from the natural forage during the greater part of the season. High winds during early fall (October 1–2, 1946) blew down much of the deer's preferred browse and, in addition, the crusted snow enabled the deer to reach food ordinarily unobtainable. The ample food supply was a contributing factor in the deer's erratic behavior toward the porcupine clippings.

The daily average of clippings by a single porcupine was estimated to be about one pound and seven ounces. This weight is scarcely sufficient to maintain a deer even if all the stems were browsed. It has been determined by the Game Research Division of Michigan (Davenport, *litt.*) that a captive adult consumes between six and six and one-half pounds of green browse per day per hundredweight of deer, and that the weight of the food of fawns is considerably higher. The possibility of sustaining deer on porcupine clippings alone seems remote when the competition for food, the amount of movement needed to reach the various porcupine feeding trees, and the probable nutritionally unbalanced diet are considered.

Nevertheless, the deer make full use of this browse in some areas, as determined by the numerous pellet groups, beds, tracks and other sign found consistently in close proximity to the feeding trees. The possibility remains that in an area where there is little competition for the clippings, the weak or unfit deer may make use of them for a short period and thus be enabled to compete with the stronger deer in the same area. On the other hand, it is possible that in some areas the clippings may add nutritionally to a diet, such as balsam, which is low in food value.

The writer does not believe that porcupine clippings would enable any large number of deer to survive or that it would materially affect the herd in general.

SUMMARY

The average weight of porcupines collected on the Anna and Archer Huntington Wildlife Station was computed to be 15 pounds; ranging from 5 to 23.5 pounds.

The foods preferred during the winter are hemlock, red spruce, sugar maple, yellow birch, and balsam fir, in that order. The animals were found to ingest about 15 ounces of woody material per porcupine per day in captivity. They displayed a preference for trees between two and ten inches in diameter, but commonly fed on thrifty trees with larger diameters. The porcupine shows a strong predilection toward previously visited trees which enables the foresters to reduce current damage through silvicultural methods.

The porcupine evacuates about three times per day. Each evacuation contains from 45 to 75 pellets which are characteristically curved and elongated with rounded ends. The total weight of the scats was computed to be 3.25 ounces per day or 22 per cent of the food ingested.

Each animal was estimated to have a winter home range of approximately 13 acres. The animal displays little or no possessiveness with respect to its den. It may occupy the den recurrently, intermittently, or abandon it completely. The den consists of any opening which affords a modicum of cover and protection from the elements.

The total value of damaged timber on the study area was computed at current prices to be $1,428.44 or $0.35 per acre. The annual damage was calculated to be 4.6 per cent of the yearly increment or $299.00 per year. The greatest damage ($0.80 per acre) was found on the lower spruce slope forest type which normally is not logged because of inaccessibility and its value as a watershed. The total amount of damage of the mixed hardwoods indicates that the animal prefers an interspersion of hard and soft woods rather than a predominance of hardwoods.

It is believed that, under natural conditions where deer are properly stocked, porcupine clippings are of no importance in the general maintenance of the herd. The amount of food dropped was insufficient to enable one or more deer to withstand adverse conditions for a very long period.

BIBLIOGRAPHY

CURTIS, JAMES D. 1941. The silvicultural significance of the porcupine. Jour. Forestry, 39: 583–594.

——— 1944. The Appraisal of porcupine damage. Jour. Wildlife Mgt., 8: 88–91.

CURTIS, JAMES D., AND E. L. KOZICKY. 1944. Observations on the eastern porcupine. Jour. Mamm., 25: 137–146.

GABRIELSON, IRA N. 1928. Notes on the habits and behavior of the Porcupine in Oregon. Jour. Mamm., 9: 33–38.

GOODWIN, GEORGE G. 1932. New records and some observations on Connecticut mammals. Jour. Mamm., 13: 38.

JELLISON, WILLIAM L. 1933. Parasites of porcupines of the Genus *Erethizon* (*Rodentia*). Trans. Amer. Microsc. Soc., 52: 42–47.

REEKS, W. A. 1942. Notes on the Canada porcupine in the Maritime Provinces. Forestry Chronical, 18: 182–187.

SPENCER, DONALD A. 1946. A Forest mammal moves to the farm—the porcupine. Trans. eleventh North Amer. Wildlife Confer.: 195–199.

STRUTHERS, PARKE H. 1928. Breeding habits of the Canadian porcupine (Erethizon dorsatum). Jour. Mamm., 9: 300–308.

TAYLOR, WALTER P. 1935. Ecology and life history of the porcupine (Erethizon epizanthum) as related to the forests of Arizona and the southwestern United States. Univ. Ariz. Bull., vol. 6, no. 5 (Biol. Sci. Bull. no. 3), 177 pp.

WEBB, WILLIAM L. 1942. A method for wildlife management mapping in forested areas. Jour. Wildlife Mgt., 6: 38–43.

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THE REPRODUCTIVE RATES OF SOME SMALL MAMMALS

BY W. J. HAMILTON, JR.

Students of cyclic mammal populations realize the necessity of properly evaluating the breeding rate. A proper assessment of the reproductive rate is frequently essential for a correct interpretation of population levels. Without a satisfactory estimate of breeding rate, conclusions regarding cyclic populations may be invalid. Unfortunately, it is difficult to secure accurate data on the breeding rate in feral species; analogous observations on captive species may not give a true picture of the breeding behavior in wild species. Many field investigators believe that small mammals have successive litters, one following another in rapid succession during the height of the breeding season. On the other hand, there are those who argue that a post-partus oestrus in wild species seldom occurs. They insist that mating during the lactation period is rare under natural conditions; captive individuals alone exhibit this phenomenon due to crowding or other factors imposed by laboratory conditions. Since the subject is an important one in population studies, I present such data as are available to demonstrate that certain shrews, mice, and other small mammals are not only capable, but do mate successfully following partus. Actively lactating species are upon occasion gravid.

In an important paper on discontinuous development in mammals, Hamlett (1935) remarks that in a fairly extensive series of mice of various kinds, including free living house mice, Norway rats, and wild species of deer mice and field mice, pregnant suckling females were never found. He concludes that copulation immediately after parturition in mice is a response to domestication, and is rare or lacking in free living races. Pearson (1944) examined early pregnant females of *Blarina* in which placental scars were visible and the mammary glands greatly developed, indicating that these individuals had been nursing young recently. He suggests the possibility that the young may have been lost or destroyed a short time before, and that mating took place after the loss of the young. Pearson believes that shrews with advanced mammary development merely indicate that it is possible for *Blarina* to produce more than one litter, but his data do not prove that there is a true post-partum oestrus. He concludes that true post-partum mating and pregnancy during lactation rarely, if ever, occur in *Blarina*; remating depends upon the loss of a litter.

Several investigators have demonstrated a post-partum oestrus in captive cricetid rodents. Bailey (1924) observed that captive meadow voles, *Microtus p. pennsylvanicus*, mated immediately following parturition, one female producing seventeen litters in a year. The gestation of this species is twenty-one days; lactation does not lengthen the period. Svihla (1932) reports several species of captive *Peromyscus* mating shortly after parturition. Practically all females of the European wild rabbit (*Oryctolagus cuniculus*) under natural conditions become pregnant again at each post-partum oestrus during the height of the breeding season (Brambell, 1943). Elsewhere (Hamilton, 1940), I have shown that the cottontail, *Sylvilagus floridanus mearnsii*, presumably has a post-partus oestrus, for actively nursing females have contained embryos, suggesting that mating occurs shortly following parturition. Vorhies and Taylor (1940), in their study of the white-throated wood rat, *Neotoma albigula*, suggest that it is highly probable that this species produces successive litters with only very short intervals. In one den they found a female with two newly born young hanging to the teats, with three half-grown young in the same den. This presumptive evidence of rapid succession in litters is nevertheless suggestive.

Obviously with the species discussed above there is a post-partum oestrus at which time the female is receptive to the male. It appears unlikely that the imposition of captivity would modify the reproductive cycle in a short time. The absolute proof of such should be studied under natural conditions, though positive data are rather difficult to secure.

A feral Norway rat will cease lactating within forty-eight hours after the loss of a litter. Gentle traction on the teats fails to produce milk following this period. Meadow voles usually cease to lactate a day after the young are removed. The short-tailed shrew, *Blarina brevicauda*, will not produce a flow of milk in a similar length of time if the nursing young be destroyed. Since such is known of these three species, we may adduce the probability of pregnant females nursing a litter if a flow of milk is possible. The mammary glands and teats swell noticeably in many mammals shortly before parturition. Interpretation of data may be faulty

if such evidence is not considered with care. A colustral flow is evident in several cricetid rodents and some insectivores shortly before parturition. Inexperienced observers may mistake this secretion for milk and draw faulty conclusions. The following data lend support to the assumption that some small mammals, under natural conditions, successfully mate shortly after parturition and produce successive litters in rapid succession during part of the breeding season. Unless otherwise stated, the observations below relate to those of small mammals under conditions in the vicinity of Ithaca, New York.

Blarina brevicauda. Short-tailed shrew.—On July 23, 1947, E. W. Jameson, Jr. collected a nursing shrew. Under gentle pressure, milk could be drawn from the posterior teats. This shrew had four embryos, the uterine swellings measured 10 mm. in greatest width, suggestive of at least half-time pregnancy. A week later I trapped a nursing *Blarina* with five 11-mm. embryos. The teats, on traction, produced milk. A *Blarina* with six 9-mm. embryos was taken on August 10, 1948. The teats were drawn out and produced milk under gentle traction. In my field notes from 1926 to 1941 I have recorded data on many hundreds of these shrews, and noted on numerous occasions the occurrence of lactating gravid females. I have always considered this condition a perfectly natural one in shrews.

Sorex f. fumeus. Smoky shrew.—Mating may follow parturition in this species (Hamilton, 1940). Actively nursing females have been taken which contained well-developed embryos. Specimens of pregnant *Sorex cinereus* have likewise been collected with prominent mammary glands containing an abundance of milk.

Peromyscus leucopus noveboracensis. White-footed mouse.—Many hundreds of adult females have been examined during the breeding season over a twenty-year period. Many of these were actively nursing and contained embryos of various sizes. Pregnant nursing individuals appear more frequently in May and June collections. It is possible that more lactating individuals were gravid than my notes indicate, since early pregnancy cannot be determined by macroscopic examination.

Oryzomys palustris. Rice rat.—This is a prolific species. Field data obtained in Virginia demonstrates that actively nursing females are occasionally pregnant; there is evidence that a high fertility, resulting in vigorous females actually producing nine litters in a breeding season, is quite possible. The females are capable of breeding when seven weeks old.

Clethrionomys gapperi. Red-backed vole.—On October 10, 1941, I took a 35-gram nursing female with four 3-mm. embryos and recent placental scars. The mammary glands, when dissected out, weighed 2.5 grams. On May 29, 1940, a nursing individual contained five 6-mm. embryos. Such data are admittedly fragmentary, but do suggest the rapidity of breeding in this species. Apparently many parous animals of the bank vole, *Clethrionomys glareolus*, are pregnant and lactating simultaneously. In such, pregnancies are prolonged by lactation causing a delay in implantation. This delay results in the blastocysts remaining in a resting state in the uterine lumen for a considerable period (Brambell and Rowlands, 1936).

Microtus pennsylvanicus. Meadow vole.—The reproductive behavior of this species in the wild is similar to that of captives. Adult females give birth to one litter after another in rapid succession. Data on this high fecundity are readily obtainable by live trapping. Females approaching full term are readily recognized; repeated captures of specific individuals indicate that in some instances young are produced at three-week intervals over a period of several successive months. The capture of numerous wild pregnant females with nest-young is indubitable proof that post-parous mating occurs normally from early spring to fall. I have obtained many records of such.

Ondatra zibethica. Muskrat.—Arthur C. Cook of the New York Conservation Department informs me (personal letter) that on June 20, 1941, he dug out a muskrat den at Howlands' Island, Cayuga County, New York. From the den he recovered a pregnant muskrat

with two litters of different size. In captivity, this gravid female suckled the smaller litter. This is presumptive evidence that the muskrat may mate following partus.

Some polyoestrous rodents, in which two litters a year are the rule, have the litters widely spaced. Mating normally occurs in the late winter and midsummer. No post-partum oestrus occurs. Deanesly and Parkes (1933) indicate that there is no oestrus immediately after parturition or during lactation in the gray squirrel, *Sciurus carolinensis*. A similar condition obtains with *Tamiasciurus*, *Tamias*, and *Eutamias*.

Where populations of small mammals are sufficiently large, it appears probable that fruitful matings often occur following partus, at least during the height of the breeding season. If such a condition be generally true, it enables one to compute, in a measure, the probable reproductive rate. One may thus visualize the annual natural increment in a population during the breeding season. Such data are most useful to students of populations and animal behavior.

LITERATURE CITED

Bailey, Vernon. 1924. Breeding, feeding, and other life habits of meadow mice (Microtus). Journ. Agr. Research, 27: 523–536.

Brambell, F. W. Rogers. 1943. The reproduction of the wild rabbit *Oryctolagus cuniculus* (L.). Proc. Zool. Soc. London, 114: 1–45.

Brambell, F. W. R., and I. W. Rowlands. 1936. Reproduction in the bank vole (*Evotomys glareolus* Schreber). I. The oestrous cycle of the female. Phil. Trans. Royal Soc. London, Series B., No. 531, 226: 71–97.

Deanesly, Ruth, and A. S. Parkes. 1933. 3. The reproductive process of certain mammals. Part 4. The oestrous cycle of the grey squirrel (*Sciurus carolinensis*) Phil. Trans. Royal Soc. London, B. 222: 47–78.

Hamilton, W. J., Jr. 1940. The biology of the smoky shrew (*Sorex fumeus fumeus* Miller). Zoologica, 25(4): 473–492.

———— 1940. Breeding habits of the cottontail rabbit in New York State. Jour. Mamm., 21: 8–11.

Hamlett, G. W. D. 1935. Delayed implantation and discontinuous development in the mammals. Quart. Rev. Biol., 10: 432–447.

Pearson, Oliver P. 1944. Reproduction in the shrew (*Blarina brevicauda* Say). Amer. Jour. Anat., 75: 39–93.

Svihla, Arthur. 1932. A comparative life history study of the mice of the genus Peromyscus. Misc. Publ. Mus. Zool. Univ. Michigan, 24: 1–39.

Vorhies, Charles T., and Walter P. Taylor. 1940. Life history and ecology of the white-throated wood rat, *Neotoma albigula albigula* Hartley, in relation to grazing in Arizona. Univ. Ariz. Agr. Exp. Sta. Tech. Bull., 86: 455–529.

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USE OF THE BACULUM IN AGE DETERMINATION OF MICHIGAN BEAVER

By Charles E. Friley, Jr.

The following study is designed to present data secured from the analysis of fifty bacula of Michigan beaver (*Castor canadensis michiganensis*) in the collection of the Museum of Zoology, University of Michigan. Aside from describing the baculum at various age levels, the material here presented may provide additional methods for roughly aging beaver. Unlike an earlier paper on age determination in the river otter, by use of the baculum (Friley, 1949), the present study is based on more nearly complete data on the beaver specimens from which these bacula were secured. The results here obtained are believed to give a true picture of the relation between the actual age of the animal and the condition of the baculum.

Acknowledgment.—I wish to thank Dr. William H. Burt and Dr. Emmet T. Hooper for helpful suggestions during the course of preparation of the paper.

Materials.—All bacula and skulls were secured from beaver carcasses sent by trappers to the Game Division of the Michigan Department of Conservation between March 15 and April 15, 1935. The carcasses were subsequently sent to the Museum of Zoology at the University of Michigan for analysis of sex ratio, age classes, breeding habits, and measurements and weights of Michigan beaver taken during the legal trapping season (Benson, 1936). Skulls are available for twenty-nine of the fifty individuals from which bacula were secured. Their measurements provide data for the primary grouping of the specimens into age classes. Weight and measurements of each carcass, as recorded in Benson's original notes, have been used only as guides, and will not be repeated here. All skeletal material was cleaned by dermestid beetles shortly after being received at the Museum.

General morphology of the baculum.—The baculum, or os penis, is located in the distal portion of the penis. Bacula are ordinarily regarded as being divisable into three regions: the head, the body, and the tail (see Plate I, upper). As regards the yearling and adult beaver baculum, the head, or proximal end, is quite enlarged, somewhat resembling the shape of the head of a golf driving club. The tail, or distal end, is only slightly larger in diameter than the body, and is somewhat bulbous. The body is between the head and tail. A slight ventral concavity of the body gives the overall shape of the baculum a curved appearance. The greatest height of the concavity is nearer the distal end than the proximal end. No distinct dividing lines are apparent between any of the parts, but the three regions are at once recognizable. The head accounts for about 30 per cent of the total length of the bone, while the body and tail together make up the remaining 70 per cent. The dorsal surface is narrow, the ventral surface is flat or concave, and the sides are flat or slightly rounded. These four surfaces all become wider in the region of the head, and are narrowest near the tail. In cross-section through the body, the bone is roughly triangular, with

the apex dorsal. The proximal face is the area of attachment to the corpus cavernosum.

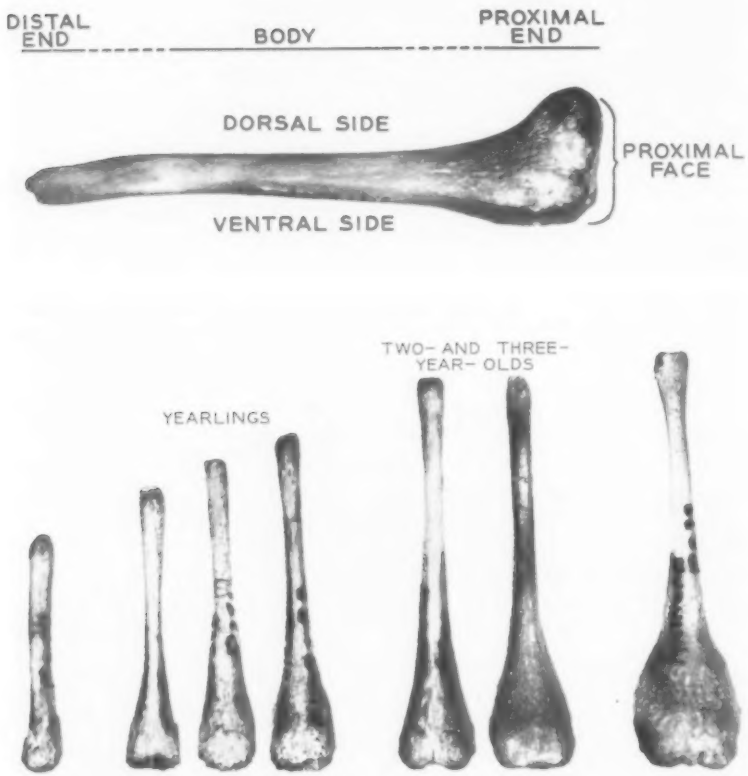

PLATE I

UPPER: Beaver baculum of the two- and three-year-old class, with parts labeled. ×3. LOWER: Dorsal view of a series of bacula showing morphological changes during development. ×2. (From left to right, nos. 279, 287, 292, 289, 300, 281, and 299. See Table 1 for measurements.)

Measurements and age groups.—Benson (*op cit.*) "—found that the beaver tended to fall into two groups; one group was evidently a yearling class, the other, two-year-olds and adults." He suggested also the possibility of dividing the older group with the aid of cleaned skulls. Such a division appears quite evi-

dent on the basis of the skull measurements recorded in Table 1. The data from the bacula lend support to this division. Of a total of nine measurements taken for each of the twenty-nine skulls, four seem to be of particular value in segregating the age classes. These measurements are: basilar length of Hensel, greatest length of mandible, zygomatic width, and height from the ventral surface of the mandible to the upper limit of the coronoid process. The first two measurements were taken as described by Taylor (1911), and the last two as described by Taylor (1916).

Deanesly (1935) and Wright (1947) have demonstrated the value of bacular weights in two species of *Mustela* in distinguishing adults from immature animals. The value of length and weight of the baculum in distinguishing age groups of *Lutra canadensis* has been pointed out by the writer in an earlier paper (Friley, *op. cit.*). Two other measurements give significant data in the case of the beaver: dorso-ventral height of the proximal end, and the ratio between the length of the proximal part and the distal part, as measured from the center of mass. In determining the height of the proximal end, the baculum was placed on its ventral surface in front of a vertical scale. The height was read directly from the scale with an accuracy of about 0.4 mm. In determing the center of mass, the baculum was balanced, ventral side down, across a pencil lead, both on a horizontally placed scale. The distances from the fulcrum (pencil lead) to the proximal and distal ends were read directly from the scale. This latter measurement is recorded in Table 1 as "head/tail-length ratio" and is reduced to percentages. As will be shown later, these last two measurements are related directly to the age of the animal.

Taylor (1916), in recording data on eleven specimens of *Castor c. leucodonta* from Vancouver Island, British Columbia, taken in June, 1910, recognized "three generations," but did not designate ages or age classes. In comparing Taylor's data with that presented here, it appears that four, instead of three, age groups were represented in his sample: young of the year, yearlings, two- and three-year-olds, and four-year-olds and over. Bradt (1938 and 1939), reporting on parturition in Michigan beaver in the wild and in pens, found that the young are usually born in late May, but may be born as late as July. Dalquest (1948) reports the birth of a single litter of beaver in Washington during the middle of May. From the above information, one might expect that the collection reported on by Taylor, taken a month or more after the usual parturition time, would contain a group of newly born individuals, and that the Michigan beaver, collected from one to two months before normal parturition, would lack this group.

Judging from skull measurements, there are three distinct age groups represented in the sample of Michigan beaver: a yearling class, a class of two- and three-year-olds, and a class of four-year-olds and over. Strictly, the bulk of these classes would be about two months younger than the class name indicates, but for the sake of convenience the classes are referred to by yearly increments. The skull measurements of the last two specimens of the two- and three-year-old class, as listed in Table 1, may very well be those of three-year-olds, while the

other four specimens with skulls may be two-year-olds. Lack of sufficient material, however, makes it undesirable at this time to venture such a separation.

Attention should be called to the skull and bacular measurements of the first two specimens in the yearling class (Nos. 302 and 279), and to the first specimen in the two- and three-year-old class (No. 300). It appears that these three specimens were either runts or late births of their respective seasons. On account

TABLE 1.—*Skull measurements (mm.), and bacula measurements (mm.) and weights (Arranged approximately in order of age from top of table to bottom)*

SKULLS					BACULA			
Baculum Number	Basilar Length of Hensel	Greatest Length of Mandible	Zygomatic Width	Ventral Surface of Mandible to Coronoid	Length	Weight (decigrams)	Dorso-ventral Height of Proximal End	Head/Tail-length Ratio, Per cent
Yearlings								
302	*84.8*	*77.8*	*71.8*	*43.5*	*18.1*	*.4*	*2.3*	*100*
279	*86.5*	*78.2*	—	*44.3*	*19.8*	*.9*	*2.8*	*100*
326					23.1	1.2	4.1	81
287	89.4*	82.9*	76.9	48.8	23.7	1.2	3.3*	85
314					23.9	1.2	4.6	76
304	92.6	83.6	78.2	49.0	22.2*	.7*	3.8	84
325					22.5	1.0	4.3	75
312					24.2	1.2	4.3	68
323					23.1	1.5	4.8	67
292	90.8	84.9	74.3*	47.5*	25.8	1.2	4.1	82
293	90.7	85.6	77.6	49.0	25.7	1.8	4.3	82
303	93.3	86.2	76.2	47.5	25.9	1.7	4.6	90*
319					26.8	1.5	4.3	86
296	92.8	86.8	80.7	48.7	27.8	1.7	4.1	79
291	94.0	89.3	77.6	50.8	25.8	1.2	3.8	74
295	93.5	88.4	79.7	50.8	27.4	1.7	4.1	68
321					25.4	1.5	5.3	74
318					25.0	2.0	5.8	70
313					27.1	1.8	5.8	64
322					27.9	1.8	5.3	65
324					27.7	2.3	4.6	79
290	95.5	86.0	77.6	49.5	28.0	2.2	4.1	72
277	93.5	85.5	81.4	49.6	28.6	2.4	4.8	76
305	94.2	87.8	79.3	49.7	28.0	2.0	5.1	59
301	95.1	90.5	79.3	51.2	27.5	2.0	5.1	68
289					28.0	1.9	5.3	63
294	98.6	91.2	79.3	51.0	28.2	2.4	5.8	54*
298	96.8	91.0	82.3	50.8	28.8	2.8	6.35	63
297	99.2	91.7	82.2	54.7*	27.6	2.1	5.8	75
282	97.0	91.3	85.7*	52.3	30.9	2.3	4.3	78
276	99.1	91.1	84.1	53.2	29.5	3.2	4.6	75
288	101.0*	92.4*	82.1	53.7	30.8	2.5	5.8	71
278					30.7	3.1	6.35*	57
311					31.5*	3.2*	5.1	58
Averages	94.8	88.1	79.7	50.4	26.8	1.9	4.8	72.4

TABLE 1—*Continued*

SKULLS					BACULA			
Baculum Number	Basilar Length of Hensel	Greatest Length of Mandible	Zygomatic Width	Ventral Surface of Mandible to Coronoid	Length	Weight (decigrams)	Dorso-ventral Height of Proximal End	Head/Tail-length Ratio, Per cent
Two- and three-year olds								
300	108.3*	95.8*	85.7*	53.1*	32.4	3.6	5.8	46
310					33.2	4.0	5.6*	55
317					29.0	3.7	6.1	47
306	109.5	99.1	89.9	57.5	28.3	3.4*	7.1	47
315					28.0*	3.8	7.1	39
275	—	100.3	—	58.0	31.8	4.3	7.1	44
327					32.7	4.1	6.9	47
316					31.4	4.3	6.35	45
280					31.4	4.3	7.4*	45
285	109.9	99.1	93.2	59.4	34.2*	5.6*	6.35	59*
281	114.7	103.8*	95.0	60.5	32.6	4.2	6.35	50
286	119.3*	103.1	96.8*	60.7*	31.6	4.1	7.1	36*
Averages	112.3	100.2	92.1	58.2	31.4	4.1	6.6	46.7
Four-year-olds and over								
284	119.1*	106.2*	102.3*	62.6*	33.5	4.8*	8.1	38
309					32.9*	6.3	7.6	43
283	119.3	106.7	98.4*	63.0	36.6*	6.9*	7.4*	50*
299	123.0*	109.6*	99.4	63.0*	34.6	6.4	8.6*	38*
Averages	120.5	107.5	100.0	62.9	34.4	6.1	7.9	42.2

Italicized data are those of "late yearlings" and are excluded in computing averages.
* Minimum and maximum figures in each age class.

of the small size of the skulls and bacula of the two yearlings, they have been excluded in determining the averages and in designating minimum and maximum limits for the yearling class. They are hereafter referred to as "late yearlings." The other specimen (No. 300) is included in its class for the determination of average measurements and designation of limits.

In establishing the sequence presented in Table 1, the twenty-nine specimens with skulls were first arranged according to their relative ages as determined from data of both skulls and bacula. The twenty-one specimens without skulls were then inserted into their appropriate places on the basis of the four bacular measurements with the aid of carcass measurements and weights from Benson's notes. Minimum and maximum figures for each measurement, in each age class, are indicated by asterisks in Table 1.

Development of the baculum.—The bacula of the two "late yearlings" show that the two ends are almost equal in size at about eight months of age. The two bones are short rods with slight terminal swellings. In the yearling class proper, there is a continuous linear growth together with expansion of the proximal end. The distal end has reached approximately its definitive shape and size, and is

fully ossified, in the larger specimens of the yearling class. The entire proximal face is porous throughout the class, no bony covering having yet formed. In the two- and three-year-olds, the bone is longer, much heavier, and more solidly ossified than in the yearling class. Linear growth appears to have taken place in the proximal portion only. The proximal face is fully ossified in all but the smallest of the group. Numerous pits on the proximal face are apparent where the baculum was attached to the corpus cavernosum. In the four-year-olds and over, ossification appears to have reached its limit, the height of the proximal end is greater than in the younger animals, and the bones are heavier and longer; in brief, the bone is approximately fully matured. The greatest developmental changes appear to take place between the ages of one and two years. Most noticeable are the increase in weight and the shift of the center of mass toward the proximal end as a result of the rapid ossification of much of the inflated head. The progressive morphological changes that take place during the development of the baculum are illustrated in Plate I, lower. The series includes bacula of the "late yearlings" as well as the three designated age classes, all of which were secured from animals collected at approximately the same time.

Peculiarities of form.—The most prominent departure from the usual shape of the beaver baculum is shown by three examples in the yearling class (Nos. 318, 323, and 312). Here the tail portion of each bone is turned dorsad, rather than being straight or curved ventrad, by a bend in the posterior part of the body. The general curvature is just the reverse of the average bone, and the posterior part of the body is much broader. No similar shape was observed in any baculum above the yearling class.

Summary.—On the basis of both skull and bacular measurements, a sample of early spring-trapped beaver is referred to the following age classes: yearlings, two- and three-year-olds, and four-year-olds and over. In a series of summer-trapped beaver, a fourth distinct class, the kits, should be found. Of the usual skull measurements taken, four of the longer ones provide good aging data: basilar length of Hensel, zygomatic width, greatest length of mandible, and height from the ventral surface of the mandible to the upper limit of the coronoid process. Any one of these measurements will give good results, but the use of all four should show the age of the specimens with a high degree of accuracy. Important bacular measurements are: length, weight, height of the proximal end, and head/tail-length ratio. While these measurements will each give good results, the use of all four will provide a high degree of accuracy. The tail of the baculum reaches its definitive shape and size in the yearling class, the body in the larger forms of the two- and three-year-olds, and the head continues to develop even in the four-year-old and over class.

LITERATURE CITED

Benson, Seth B. 1936. Notes on the sex ratio and breeding of the beaver in Michigan. Occ. Papers Mus. Zool. Univ. Mich., 335: 1–6.

Bradt, Glen W. 1938. A study of beaver colonies in Michigan. Jour. Mamm., 19: 139–62.

——— 1939. Breeding habits of beaver. Jour. Mamm., 20: 486–9.

Dalquest, Walter W. 1948. Mammals of Washington. Univ. Kansas Publ., Mus. Nat. Hist., 2: 1–444.

Deanesly, Ruth. 1935. The reproductive processes of certain mammals. Part IX. Growth and reproduction in the stoat (*Mustela erminea*). Philos. Trans. Roy. Soc., London, Ser. B., 225, no. 528: 459–92, pls. 28–31.

Friley, Charles E., Jr. 1949. Age determination, by use of the baculum, in the river otter, *Lutra canadensis canadensis* Schreber. Jour. Mamm., 30: 102–110.

Taylor, Walter P. 1911. Mammals of the Alexander Nevada Expedition of 1909. Univ. of Calif. Publ. in Zoology, 7: 205–307.

———— 1916. The status of the beavers of western North America, with a consideration of the factors in their speciation. Univ. of Calif. Publ. in Zoology, 12: 413–95.

Wright, Philip L. 1947. The sexual cycle in the male long-tailed weasel (*Mustela frenata*). Jour. Mamm., 28: 343–52.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan. Received June 17, 1948.

A LONG-SNOUTED DOLPHIN FROM THE WASHINGTON COAST

By Karl W. Kenyon and Victor B. Scheffer

On 13 March 1948 the senior author found the carcass of a dolphin on the ocean beach about five miles south of Westport, Washington. The dolphin had been dead a week or more. The carcass was so mutilated that the sex could not be determined. The true color pattern had been altered by exposure and decay. The general color was blackish, with two dark streaks extending backward from the eye. These show faintly in Plate I.

The dolphin appears to be *Stenella euphrosyne* and is the second of its kind reported from North America. A specimen was recovered from the Oregon coast about 1940 (Murrelet, 1947, 28: 9). The Oregon and the Washington specimens agree in the shape of the head and the pattern of two dark streaks behind the eye. Many of the skull dimensions of the Oregon specimen are slightly less than those of the Washington specimen, a fact that we attribute to a difference in age.

External measurements of the Washington specimen (BDM 244; USBS 33133×) are, in millimeters: snout to base of tail notch, 2192 (8.6 feet); maximum width across tail flukes, 380; length of beak, 111; height of dorsal fin, 150; axillary length of flipper, 145; corner of mouth to snout, 275; snout to center of eye, 330; ear to center of eye, 67; projection of lower jaw beyond snout, 4; longest exposed portion (crown) of any tooth, 7. Skull: maximum condylobasal length, 437; maximum length of rostrum, 253; width of rostrum at bases of antorbital notches, 104; width of rostrum 60 mm. anterior to antorbital notches, 75; maximum (zygomatic) breadth, 208; width of braincase across parietals, 164; number of teeth in upper row, right 48, left 50; length of upper tooth row, right 218, left 218; number of teeth in lower tooth row, right 48, left 47; length of lower tooth row, right 213, left 213; maximum length of mandible, right 374, left 372; maximum height of mandible through coronoid process, right 63, left 63.

The teeth are conical, curved inward, strong, and well rooted. All of them

PLATE I

Long-snouted dolphin. Upper: ventral view of cranium (Photo 2355). Lower: mutilated head (Photo 2341). Specimen BDM 244; USBS 33133×

remained in place during the cleaning of the skull. (The first three pairs in the mandible are worn off or broken off below the surface of the jaw.) The largest tooth is about 3 mm. in antero-posterior diameter and 4 mm. in transverse diameter. It is exposed above the jaw bone for 10 mm. of its length.

U. S. Fish and Wildlife Service, Seattle, Washington. *Received June 1, 1948.*

THE CLITORIS BONE IN TWO PINNIPEDS

By Victor B. Scheffer

We have found a clitoris bone in a fur seal, *Callorhinus ursinus*, and in two harbor seals, *Phoca vitulina*, all from St. Paul Island, Alaska.

The fur seal, a 4-year-old adult, was killed August 1, 1945. Weight, 79 pounds; length of bone, 21 mm.; specimen, BDM 168 (Pl. I, left). The clitoris was abnormally large, the ovaries small, and the uterine horns small and equal. The animal was not in breeding condition, and was perhaps incapable of breeding. Most 4-year-old seals at this time of year have given birth to the season's young. We boiled the clitori of five other fur seals in dilute aqueous ammonia and found no bones.

A harbor seal, adult and pregnant, was killed June 15, 1944. Weight, 234 pounds; length of bone, 6 mm.; specimen, BDM 54 (Pl. I, middle). Another harbor seal, adult, was killed June 16, 1944. Weight, 153 pounds; length of bone, 9 mm.; specimen, BDM 55 (Pl. I, right).

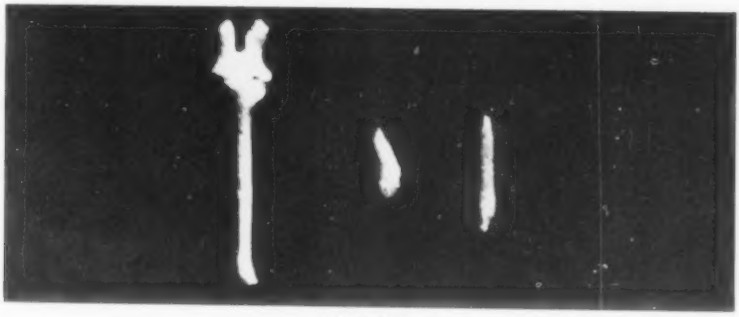

PLATE I

Left: *Os clitoridis* of fur seal, dorsal view. The forked end is the basal or anterior end.

Middle and Right: *Os clitoridis* of two harbor seals, orientation unknown. (Photo 2363) All twice natural size.

The males of both *Callorhinus* and *Phoca* have well-developed penis bones (bacula). We suspect that a clitoris bone occasionally appears in females of a mammalian species where the male normally has a penis bone. Furthermore, where the clitoris bone occurs sporadically it probably varies greatly in size and shape. The bone occurs regularly in the primitive rodent, *Aplodontia*, and perhaps in a few other mammals. Given below are annotated references to the clitoris bone in various genera of mammals.

REFERENCES

Jellison, W. L. 1944. [Personal communication, 12th February; *Ursus* and *Martes*.]

Rinker, George C. 1944. *Os clitoridis* from the racoon. Jour. Mamm., 25: 91–92. [*Procyon* and *Hystrix*]

SCHEFFER, VICTOR B. 1939. The *os clitoridis* of the Pacific otter. Murrelet, 20:20-21. [*Lutra*]

———— 1944. An *os clitoridis* from Aplodontia. Jour. Mamm., 23:443.

SIMOKAWA, SEIMATU. 1938. Einige Bemerkungen über den Clitorisknochen. Keijo Jour. Medicine, 9: 273-282, [with 8-item bibliography]. [*Felis, Mustela, Mus, Cavia, Sciurus, Eutamias*, and *Rhinolophus*]

U. S. Fish and Wildlife Service, Seattle, Washington. *Received June 1, 1948.*

THE CEREBRAL CORTEX OF THE CHIMPANZEE AT THE TIME OF BIRTH

BY W. RIESE

Problem, material, method.—The study of the mammalian brain at the time of birth and its correlation with behavior revealed some unexpected and rather surprising results reported in previous papers. The general conclusion reached was that sustained extra-uterine life and nervous functions do not necessarily require mature nervous structures. This conclusion was reached by the study of the brains of lower mammals at birth. Only two brains of new-born primates have

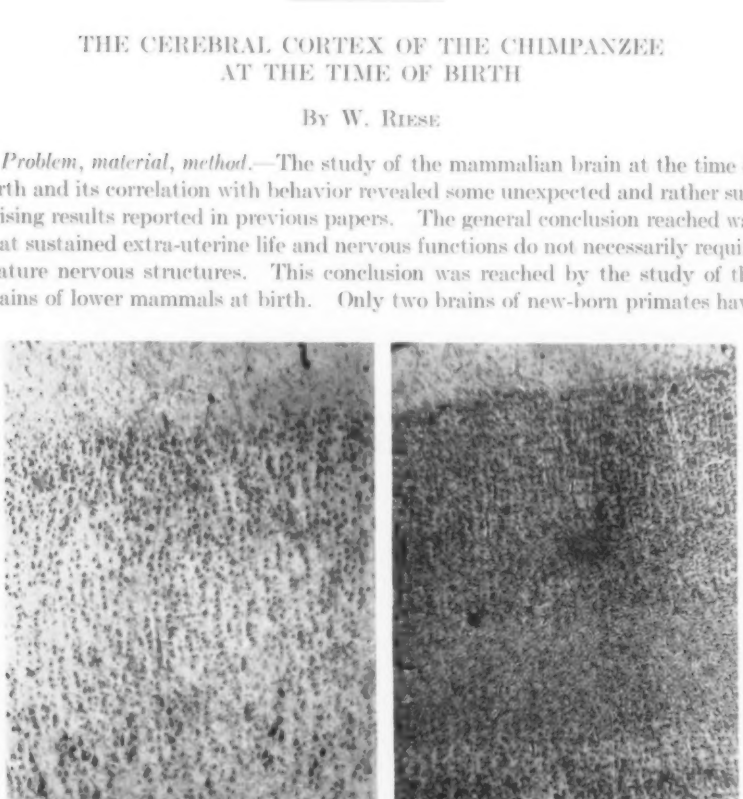

PLATE I

LEFT: Area 4 (motor area) of a 12-day chimpanzee; Nissl. × 70
RIGHT: Area 17 (visual area), same as above; × 70

been studied so far, that of the human infant (Conel, 1939) and that of *Macaca cynomolgus* L. (Riese, 1940). At the time of birth the brain of the chimpanzee has already its definite and basic convolutional pattern (Coupin, 1925); thus, from a purely morphological viewpoint, it is a finished brain. This study deals with the cytoarchitecture and the cellular structure of the cerebral cortex of a 12-day old chimpanzee of the Yerkes Laboratories of Primate Biology, Orange Park, Florida (having died of pneumonia). I wish to express my gratitude to Dr. K. S. Lashley. The brain was embedded in celloidin, and cut in serial sections. One hemisphere was stained with Nissl's, the other with Weil's method. The results of the myelogenetic studies will be reported later. There exists no complete chart of the cytoarchitecture of the cortex of the adult chimpanzee. The writer used the descriptions and pictures reproduced by G. v. Bonin (1944) and Solnitsky and Harman (1946) for comparison. The following cortical areas were studied: 3, 4, 17, 23, 44. Of these areas at least three are of known physiological significance, area 4 is related to voluntary motion, area 17 to vision; area 3 is a sensory field.

Results.—In all of the areas examined the cytoarchitecture was finished and there was no basic difference between the cortical lamination in the adult chimpanzee and that in the new-born. Regional variations in the tectogenetic 6-layer type were striking (Pl. I) and the three fundamental processes (distinguished in the human brain by C. v. Economo) of pyramidization (area 4), granulization (area 17), and spindlization (area 23) were obvious. Granulization (koniocortex) was more marked in the new-born than in the adult chimpanzee, and the density of cells in area 17 was remarkable. Thus, from the cytoarchitectural viewpoint, the cerebral cortex is finished, and insofar there is correspondence between morphogenesis and histogenesis in the cortex of the new-born chimpanzee. However, the structure of the individual cortical cell, evaluated according to the criteria established by Riese and Smyth (1940), was still immature. The most mature elements were found in the third and fifth layers, the fifth layer of area 4 (Betz' cells) contained more mature cells than any of the areas studied. But even these still displayed signs of immaturity, the spatial orientation still being at fault in some of them, their cytoplasmic bodies still lacking Nissl bodies, their nucleolus frequently being eccentric in position and harboring more than one nucleus. Thus, from a cytogenetic viewpoint, the cerebral cortex of the new-born chimpanzee is still unfinished. Cytoarchitecture precedes cytogenesis.

Interpretation.—It can be assumed that there is no major difference between the cortical structure of man, macaca, and chimpanzee at the time of birth. The gestation period being 266 days for man, 231 days for the chimpanzee, and 165 days for macaca, it must again be concluded that the developmental stage a given brain may reach at birth is not proportionate to the gestation period. (Riese, 1944, 1945, 1948.) The infancy of the chimpanzee comprises only two years, childhood six years, and adolescence (beginning with puberty) lasts from eight to twelve years or later. The life span is unknown. Yerkes (1943), from whom we borrowed these data, stated that under the most favorable circumstances the life span may be fifty years. It is obvious that the life cycle as a

whole is shortened in comparison with man and that the onset of the various life periods is at an earlier date. This might account for the relative acceleration of brain development in the chimpanzee. As shown in previous investigations, the structure of the cortex at birth in lower mammals (carnivora, rodentia) is not characteristic for the group, but rather for the species. It seems that the primates deny this law and that the cortical organization here described represents the structural minimum needed for extra-uterine life by a primate under natural conditions, regardless of the species. Further studies of the cortex in new-born primates and other mammals are necessary to give a definite answer to the question whether an exceptional place must be assigned to the primates as a group in the comparative anatomy of the brain at the time of birth.

Any statement as to the function of the cortex of the new-born chimpanzee remains hypothetical. According to Yerkes (1943), in the new-born chimpanzee social dependence is complete; the baby ape cannot walk or climb about freely for from three to six months. The helplessness of the human new-born requires no comment. According to Kennard (1938) the normal infant macaque has a relatively high degree of independent motor function at birth, as compared with man and the anthropoid. All new-born monkeys cling unaided to their mothers and suck at the nipple a few minutes after birth. Placed on a flat surface they will promptly right themselves, and a few are able to stand somewhat unsteadily and on a broad basis. Thus, the same structural (cortical) organization is related to different types of behavior in the three species. Neither the cerebral cortex of the new-born human child nor that of the new-born chimpanzee have been explored by electrical stimulation. But the "pyramidal" type of movement was elicited in a fetal monkey of only 135 days' gestation age (Hines, 1937). An inhibitory central mechanism (chalasis) could be elicited in fetal monkeys of the same age, and according to Kennard (1944), the "quieting effect" believed to be "a sort of generalized inhibitory action," is the first action that becomes electrically excitable in the fetal cortex. Thus, the structural (cortical) organization here described as common to monkey, ape, and man at the time of birth responds to electrical stimulation at least in the monkey, and it displays even the two basic types of nervous activity—excitation and inhibition.

Summary.—The cerebral cortex of a 12-day old chimpanzee has been studied; it is finished as to cytoarchitecture, but still unfinished as to the structure of the individual cell. The structural plan of this cortex is the same as that of the new-born monkey (*Macaca cynomolgus* L.) and human infant; the gestation period differs in these three species. The behavior of the three species being different at the time of birth, the same cortical organization must be correlated with different behavior.

LITERATURE CITED

Bonin, G. v. 1944. Architecture of precentral motor cortex and some adjacent areas in the precentral motor cortex. Edited by Paul C. Bucy. The University of Illinois Press, Urbana, Illinois. pp. 7–82.

Conel, J. LeRoy. 1939. The postnatal development of the human cerebral cortex. Vol. 1, The cortex of the newborn. Harvard University Press. 114 pp., 98 pls.

COUPIN, F. 1925. Etudes d'un cerveau de chimpanzé nouveau-né. Bull. Soc. Anthrop., Paris.

HINES, M. 1937. The motor cortex. Bull. Johns Hopkins Hosp., 60: 313–336, 1 fig.

KENNARD, M. 1938. Reorganization of motor function in the cerebral cortex of monkeys deprived of motor and premotor areas in infancy. Jour. Neurophysiol., 1: 477–496, 10 figs.

——— 1944. Discussion of Kennard and Welch. The relation of the cerebral cortex to spasticity and flaccidity. Trans. Amer. Neurological Assoc., Seventieth Annual Meeting. pp. 158–164.

RIESE, W. 1940. Structure et fonction du cerveau du macaque nouveau-né (Macaca cynomolgus L.). Bull. du Muséum National d'Histoire Naturelle, 2e Série. Tome XII, Nos 2, 3, et 4. pp. 92–98.

——— 1942. Structure and function of the brain of the new-born bear (Ursus arctos L.). Revue Canadienne de Biologie, vol. 1, no. 2, pp. 157–170, 2 figs.

——— 1944. Structure and function of the mammalian cerebral cortex at the time of birth. Virginia Medical Monthly, vol. 71, no. 3, pp. 134–139, 5 figs.

——— 1945. Structure and function of the brain of the opossum (Didelphis virginiana) at the time of birth. Jour. Mamm., 26: 148–53, 1 pl.

——— 1948. The early postnatal development of the brain of the opossum (*Didelphis virginiana*). Jour. Mamm., 29: 150–155, 1 pl.

RIESE, W., AND G. E. SMYTH. 1940. The cytology of the cortex in the opossum (Didelphis virginiana) considered in relation to some general problems of cortical evolution. Proc. Konink, Nederland. Akad. van Wetenschappen, 43:403–9.

SOLNITZKY, OTHMAR, AND PINCKNEY J. HARMAN. 1946. A comparative study of the central and peripheral sectors of the visual cortex in Primates, with observations on the lateral geniculate body. Jour. Comp. Neur., 85: 313–420.

YERKES, ROBERT M. 1943. Chimpanzees. New Haven, Yale Univ. Press. pp. 1–321, 24 figs., 63 pls.

Medical College of Virginia, Richmond, Virginia. *Received October 4, 1948.*

A SPECIMEN OF *SOTALIA TËUSZII* KUKENTHAL FROM THE COAST OF SENEGAL

By F. C. Fraser

During the Danish "Atlantide" expedition to West Africa in 1946 a short visit was made to the Institut Français d'Afrique Noire at Dakar. Among other cetacean specimens made available for examination was a dolphin skull from an animal which had been caught at sea in a shark net in 1943. The place of capture was at M'Bour about fifty miles south of Dakar.

It was thought that the specimen belonged to the species *Sotalia tëuszii*, described by Kukenthal (Zool. Jahrb., Abt. Syst., VI: 442–446, Pl. XXI, 1892), but

Table 1.—*Skull measurements of the type and Senegal specimens of Sotalia tëuszii*

Measurement	I.F.A.N. specimen Senegal		S. tëuszii type B.M. reg. no. 93.8.1.1. Cameroons	
	mm.	Percentage	mm.	Percentage
Total length of skull	453	100.0	503	100.0
Rostrum length	261	57.6	299	59.4
Rostrum, basal width	104	22.7	124	24.7
Rostrum, width 60 mm. anterior to base	79	17.4	86	17.1
Breadth across preorbital angles of supra-orbital processes	186	41.1	211	41.7
Breadth across postorbital angles of supra-orbital processes	200	44.2	226	44.9
Zygomatic breadth	202	44.6	227	45.0
Width of braincase across parietals	176	38.9	179	35.6
Maximum width of premaxillae	84	18.5	86	17.1
Length of upper tooth row (to tip of premaxillae) R	224	49.4	250	49.7
Length of upper tooth row (to tip of premaxillae) L	222	49.0	255	50.7
Length of lower tooth row (to end of mandible) R	210	46.4	247	49.1
Length of lower tooth row (to end of mandible) L	204	45.0	245	48.7
Maximum length of mandible	375	82.7	424	84.3
Height of mandible at coronoid	85*	18.8	96	19.1
Length of symphysis	78	17.2	98	19.4

* Doubtful measurement.

verification had to be deferred until the type specimen in the British Museum could be examined. Notes and measurements were taken and later photographs of the skull were provided by the Institut for comparison with the type. The original specimen was caught in the naval harbour, Cameroons, and is noteworthy not only because it is the only known species of *Sotalia* from African waters but also because the animal was reported to have tubular extensions of the nostrils "like the erected ears of a hippopotamus." In addition the stomach contents—leaves, mangrove fruits, and a little grass—indicated a kind of diet not known in any other cetacean.

General comparison and skull measurements show that the Senegal skull belongs to the species *Sotalia tëuszii*. The dimensions of the skull are stated in Table 1. The Senegal specimen is somewhat smaller than the type and is obviously from a younger animal, the skull sutures being clearly defined. The per-

centage proportions indicate the close similarity between the two specimens. The teeth also are comparable in size and number; the respective tooth formulae being: type, $\frac{28}{27}, \frac{27}{27}$; Senegal specimen, $\frac{28}{27}, \frac{29}{26}$.

In general appearance the Senegal skull like the type is strong and robust. The rostrum is long, narrow, and laterally compressed; the rostral portions of the

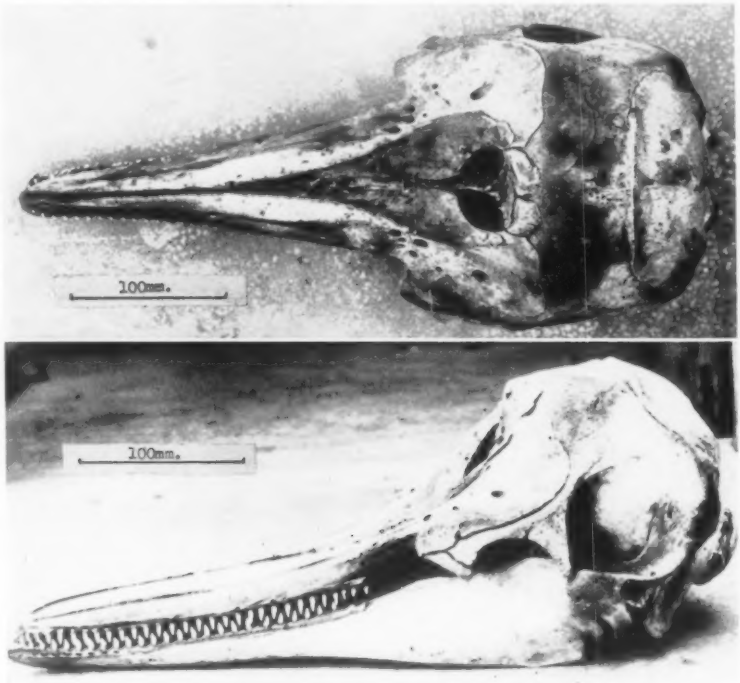

PLATE I

Dorsal and lateral views of the Senegal specimen of *Sotalia tēuszii*

premaxillae are well developed, rising prominently above the adjacent maxillae. The prenarial triangle is depressed, its apex reaching to about the middle of the rostrum. A wide area separates the hinder margin of the maxillae and the nasals from the occipital crest. The post-temporal fossae are large and rounded. The pterygoid bones have the inner borders of their inferior surfaces widely divergent posteriorly and are not united in the middle line. The mandibular symphysis is long. In all these features the Senegal specimen corresponds with the type. The shape of the anterior margin of the blowhole is however different in the two specimens. In the type the right and left portions form a fairly acute angle, whereas in the Senegal specimen they form an arc of a circle interrupted by only

a narrow tapering extension forwards in the middle line. It is not considered that this difference weakens the conclusion that the two specimens belong to the same species (Pl. I).

The Senegal specimen, apart from being the first to be recorded since the type was described over fifty years ago, is also noteworthy because of the evidence it provides of the extension of the range from the type locality to a place some two

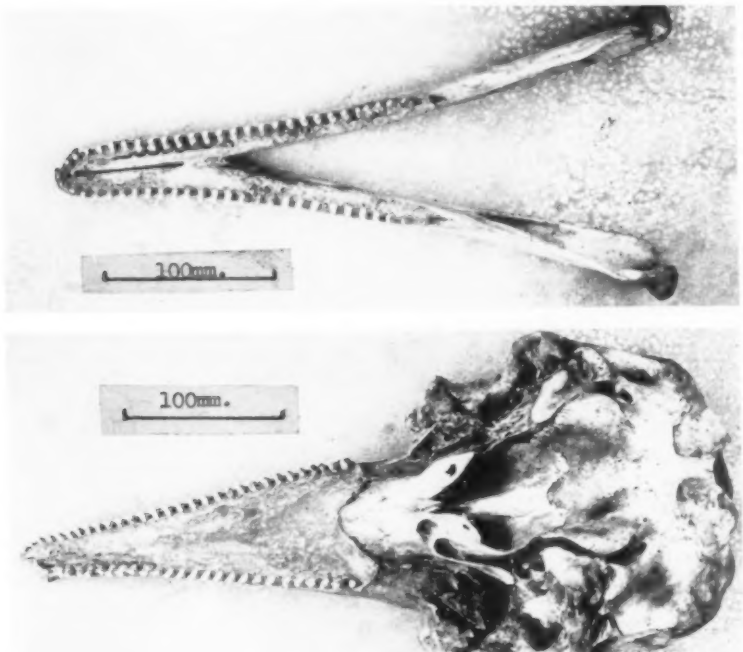

PLATE II

Mandible (upper) and ventral view (lower) of the Senegal specimen of *Sotalia tëuszii*

thousand miles westwards. *S. tëuszii* may be expected along this stretch of African coast and to those interested in cetaceans it is very desirable that specimens in the flesh should be obtained so that more may be known of the coloration, form, and internal anatomy of this rare species.

I am very much indebted to the members of the staff of the Institut Français d'Afrique Noire for the facitilites they provided for the examination of the skull and for the photographs subsequently forwarded to me. I wish especially to thank Dr. Jean Cadenat for telling me about the specimen in the first place while we were in "Atlantide" together before arriving at Dakar.

Department of Zoology, British Museum (Natural History). *Received August 30, 1948.*

MAMMALS FROM THE RIO UCAYALI, PERU

By Colin Campbell Sanborn

There have been four reports published on the mammals of the Rio Ucayali. These are on the collection made by Deville and Castelnau, mainly at or near Sarayacu (Gervais, 1855); a small collection made by Edward Bartlett in the 1860's (Bartlett, 1871); the 157 specimens collected by Latham Rutter (Thomas, 1924, 1928*a*); and on a collection of over 300 mammals made by Russell W. Hendee (Thomas, 1928*b*).

The present collection of 341 specimens was sent by Sr. Jose Schunke of Pucalpa, who was commissioned to collect for the Chicago Natural History Museum in 1944 and who worked on the Ucayali until 1947. There are 65 species represented, 18 of them not heretofore recorded from the region.

Sr. Schunke collected most of the mammals near his home on the banks of Lake Yarinacocha, about five miles northwest of Pucalpa (Fig. 1). He made one trip to Contamana and Cerro Azul down river from Pucalpa and another to the Cordillera Azul, locally known as "Divisoria," the watershed between the Rios Huallaga and Ucayali.

The author collected for a few days with Sr. Schunke at his home in March 1946 and then went up river to Agua Caliente on the Rio Pachitea, the site of the Ganso Azul oil field for eight days' collecting. From here he went down river to Iquitos. Many small settlements are being established on the Ucayali and near them the game such as peccary, squirrel, otter, tinamou, and any animal with a market value or that is edible is being rapidly shot out.

While Sr. Schunke did not get all the mammals recorded from the Ucayali, the collection does illustrate in part the fauna during all seasons of the year. It is particularly rich in bats, 28 species being represented and 11 of them recorded for the first time from the Ucayali. There are no mammals in the collection that would not be expected to occur in the region, but many do represent extensions of range.

ANNOTATED LIST

Caluromys laniger ornatus Tschudi

Didelphis ornata Tschudi, 1844–46, Fauna Peruana, pp. 146–148.
Yarinacocha: 1 male, 2 females, Apr., Aug., Sept., 1945–46; Agua Caliente: 1 male, Apr., 1946 (C.C.S.).

Marmosa germana rutteri Thomas

Marmosa rutteri Thomas, 1924, Ann. Mag. Nat. Hist., ser. 9, vol. 13, p. 536.
Yarinacocha: 1 female, June, 1945.

Philander opossum canus Osgood

Metachirus canus Osgood, 1912, Field Mus. Nat. Hist., Zool. Ser., vol. 10, p. 96.
Yarinacocha: 1 female, Mar., 1946 (C.C.S.).

Metachirus nudicaudatus infuscus Thomas

Metachirus nudicaudatus infuscus Thomas, 1923, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 606.
Yarinacocha: 1 male, Oct., 1945; Cerro Azul: 1 juv. male, Apr., 1947.

Didelphis marsupialis Linnaeus

Didelphis marsupialis Linnaeus, 1758, Syst. Nat., ed. 10, p. 54.
Yarinacocha: 1 skull only, Jan., 1945.

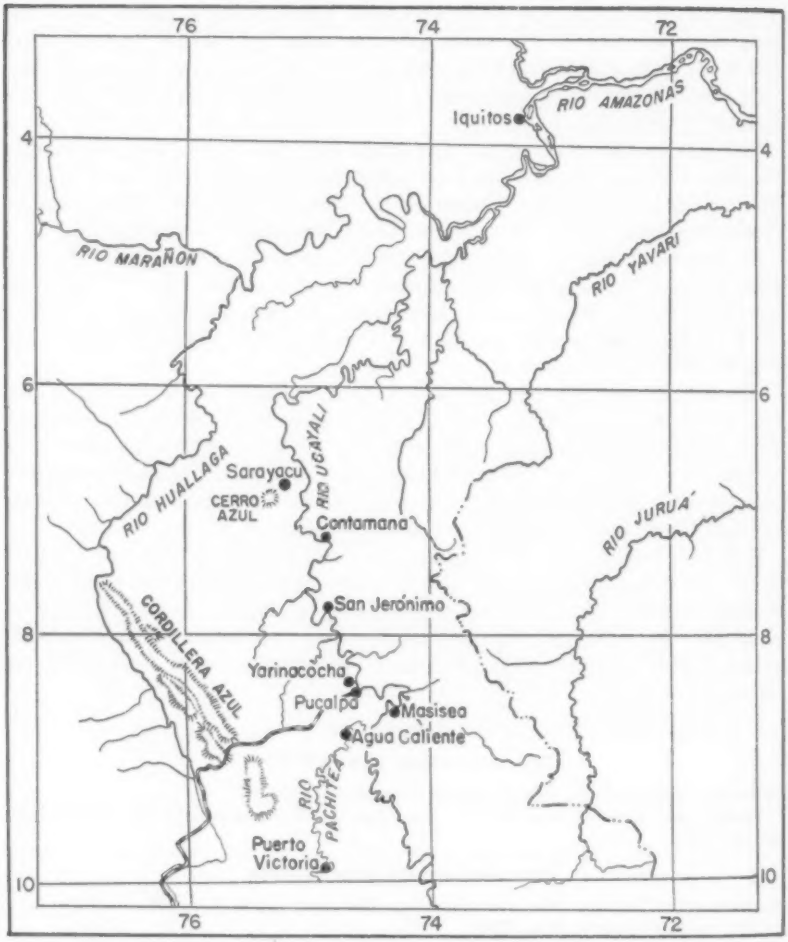

FIG. 1.—Localities on the Rio Ucayali. Map by Margaret Bradbury.

Rhynchiscus naso Maximilian

Vespertilio naso Maximilian, 1820, Reise nach Brasiliens, vol. 1, p. 251, footnote.
Yarinacocha: 1 male, 4 females, 8 alc., May, July, Aug., 1946.
The species was recorded by Thomas (1928*a*) from Contamana and San Jeronimo.

Saccopteryx bilineata Temminck

Urocryptus bilineatus Temminck, 1838–39, Van der Hoven's Tijdschr. Nat. Gesch. en Physiol., vol. 5, p. 33.

Yarinacocha: 1 male, 1 female, Apr., 1946.

Saccopteryx leptura Schreber

Vespertilio leptura Schreber, 1774, Säugeth., vol. 1, pl. 57.

Yarinacocha: 1 female, May, 1946 (C.C.S.).

A specimen from Bellavista, eastern Peru, is the only other published record for Peru (Sanborn, 1937).

Peropteryx macrotis macrotis Wagner

Emballonura macrotis Wagner, 1843, Archiv. f. Naturg., vol. 9, p. 367.

Yarinacocha: 4 males, 5 females, Apr., 1946.

This is the second record for this species from the Rio Ucayali, one specimen having been recorded from Lagarto (Sanborn 1937). It has also been taken at Matchu Picchu in southern Peru (Thomas, 1920).

Noctilio leporinus leporinus Linnaeus

Vespertilio leporinus Linnaeus, 1758, Syst. Nat., ed. 10, p. 32.

Yarinacocha: 1 male, 3 females, May, Aug., 1946.

Noctilio (Dirias) albiventer Spix

Noctilio albiventer Spix, 1823, Sim. Vesp. Brasil., p. 58.

Yarinacocha: 4 males, 5 females, Feb., May, July, Aug., 1946; Pucalpa: 3 males, Feb., Mar., June, 1947.

Geographically the nearest described species is *Noctilio zaparo* Cabrera (1907) from the Rio Napo in eastern Ecuador. Its difference from *albiventer* does not appear to be very great, but spirit material is not available for complete examination of the characters. The width at the base of the canines is given as 8.2 mm. and the length of the upper tooth row as 7.2 mm. In all other *Noctilio* skulls measured it has been found that the length of the tooth row is always greater than the width at the base of the canines so this may be a transposition. The forearms of the Ucayali series measure 63.3 to 68.7 mm.

Pteronotus suapurensis J. A. Allen

Dermonotus suapurensis J. A. Allen, 1904, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 229.

Yarinacocha: 1 male, Apr., 1946.

This bat was described from Suapure, Venezuela, and has been recorded from Panama (Allen, 1935), Costa Rica (Sanborn, 1932*b*), and Nicaragua (Goodwin, 1942, *P. s. centralis*). The present specimen agrees with material from Panama (forearms 50–54 mm.) and is about the size of *centralis* Goodwin from Nicaragua.

Micronycteris megalotis megalotis Gray

Phyllophora megalotis Gray, 1842, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 257.

Yarinacocha: 2 males, Mar., 1946; Agua Caliente: 3 males, 3 females, Apr., 1946 (C.C.S.).

Known from the Rio Huallaga, this is the first record for the Ucayali. The specimens from Agua Caliente were found roosting in two sections of an old iron smoke stack lying on the ground. After twice disturbing the colony to collect this series, the remaining ten to fifteen returned to the roosting place.

Macrophyllum macrophyllum Maximilian

Phyllostoma macrophyllum Maximilian, 1825, Beitr. zur Naturg. Brasil., vol. 2, p. 188.

Yarinacocha: 14 females, May, July, 1946.

This bat, whose known range is Panama, British Guiana, Colombia, and Brazil has but once previously been recorded from Peru. Thomas (1928*a*) listed one specimen from San Jeronimo, Rio Ucayali.

Tonatia amblyotis amblyotis Wagner

Phyllostoma amblyotis (Natt. M. S.) Wagner, 1843, Arch. f. Naturg., p. 365.

Yarinacocha: 1 male, 9 females, Mar., Apr., Oct., 1945, Sept., 1946; Pucalpa: 2 females, Nov., 1947.

Anthorhina peruana Thomas

Anthorhina peruana Thomas, 1923, Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 693.

Yarinacocha: 2 males, Aug., 1946.

The type locality for this species is the Rio Pachitea, the mouth of which is a short distance up the Ucayali above Pucalpa. It was described from one specimen, a female, and later Thomas (1927) recorded a male from Yurac Yacu, Dept. San Martin, but without comment.

These two males from Pucalpa differ from the description of the type in that the edges of the lower half of the lancet are slightly crenulate, and in the presence of large light-colored postauricular patches, the latter possibly being a male character.

Measurements.—Forearm, 49–51 mm. Skull: total length, 22.9 mm.; condylo-basal length, 19.9; zygomatic width, 12.5; mastoid width, 11.2; width of braincase, 8.5; upper tooth row, 7.9–8; width across canines, 5.4; across last molars, 8.8–8.9.

Phyllostomus hastatus hastatus Pallas

Vespertilio hastatum Pallas 1767, Spicalegia, Zool., vol. 3, p. 7.

Yarinacocha: 7 males, 6 females, Mar., Apr., May, Aug., Sept., 1946; Agua Caliente: 1 male, Apr., 1946 (C.C.S.).

This is the first record for this common bat from the Ucayali region. The specimen from Agua Caliente was taken in a bat net with a number of *Artibeus*.

Vampyrum spectrum Linnaeus

Canis volans maxima aurita Seba, 1634–1665, Thes., vol. 1, p. 92, t. 58, fig. 1.
Vespertilio spectrum Linnaeus, 1758, Syst. Nat., ed. 10, p. 31.
Vespertilio guianensis Lacepede, 1799, Buffon, Hist. Nat., ed. Didot, vol. 13, p. 188.
Vespertilio nasutus Shaw, 1800, Gen. Zool., vol. 1, pt. 1, p. 142.
Vespertilio maximum Geoffroy, 1806, Ann. Mus. Hist. Nat. Paris, vol. 8, p. 202.
Phyllostoma spectrum, Geoffroy, 1810, Ann. Mus. Hist. Nat. Paris, vol. 15, p. 174, pl. 11 (head and skull).
Vampyrus spectrum, Leach, 1822, Trans. Linn. Soc., vol. 13, p. 80.

Type locality.—Surinam (Thomas, 1911, Proc. Zool. Soc. London, p. 130).

Yarinacocha: 1 female, Mar., 1946.

This bat has been known for nearly three hundred years, but available references record not more than 20 to 25 specimens existing in museums today.

Its range has been broadly given as Central America, Jamaica, Guianas, and Brazil. The exact range as known today is Vera Cruz, Mexico, Nicaragua, Costa Rica, Panama, Jamaica, Trinidad, British and Dutch Guiana, Venezuela, northern Brazil, Ecuador, and Peru. Thomas selected Surinam (Dutch Guiana) based on Seba for the type locality.

Dobson, Jentink, Beebe, and Anthony have recorded specimens from British Guiana. Material from Trinidad is listed by J. A. Allen, Vesey-Fitzgerald, Ditmars, and Sanborn, and Dobson refers to a specimen from Jamaica. Osgood published the only record for Venezuela. The Brazilian records date back to the "andira-guacu" of Piso and the specimens recorded by Lund from Lagoa Santo (Kong. Dansk. Viden. Selsk. Natur. Math. Afhand. vol. 9) in 1842. Burmeister never saw a specimen in Brazil. While Dobson (Cat. Chirop., 1878, p. 471) does not include Peru in his range for *spectrum* he lists a purchased specimen from Cosñipata which undoubtedly refers to that locality in the Paucartambo region of

Cuzco, southern Peru. The specimen may have been collected by H. Whitely from whom other material was received from Peru. The only record for Ecuador is a specimen in the Chicago Natural History Museum, received recently from Canchacoto-west and collected in August 1939.

The "*Andira-aca*" of Margrav, listed among the birds on p. 213, was said by Lichtenstein (K. Akad. Wiss. Berlin, Phys. Kl., 1814–15, p. 217 [1817]) to refer to the European *Vespertilio murinus*. The names *nasutus* Shaw, *guianensis* Lacepede, and *maximus* Geoffroy, were all based on the "La Grande serotine de Guianne" of Buffon (suppl., vol. 7, p. 289, pl. 73, 1789), which is *V. spectrum* Linnaeus.

A northern race, *V. s. nelsoni*, was described by Goldman from Vera Cruz, Mexico, and specimens from Nicaragua and Panama were referred to it. The only other Central American locality is Costa Rica from where Peters had one specimen.

Dr. Ditmars (1935, Bull. N. Y. Zool. Soc., vol. 38, pp. 213–218) found *Vampyrum* in Trinidad living in large hollow ceiba trees where dried rat tails and feathers on the floor of the hollow led to its discovery. Four were taken alive to the Bronx Zoo. The type of *nelsoni* "flew one evening through the open door of the American Consulate at Coatzacoalcos, where Mr. Nelson happened to be sitting and was secured by him." The Peruvian specimen collected by the author flew into an open-sided palm thatched house, where a gasoline lantern was burning, and went to roost in the eaves.

The Peruvian and Ecuadorian specimens show no marked differences in either skin or skull from the Trinidad and Venezuelan material.

Glossophaga soricina soricina Pallas

Vespertilio soricinus Pallas, 1766, Misc. Zool., pp. 48–53, tab. IV, figs. 16–18, tab. V.

Pucalpa: 2 males, 6 females, Jan., Mar., July, 1947.

Carollia perspicillata perspicillata Linnaeus

Vespertilio perspicillatus Linnaeus, 1758, Syst. Nat., ed. 10, p. 31.

Yarinacocha: 2 males, 4 females, Dec., 1945, July, Aug., 1946; Pucalpa: 1 female, Mar., 1947.

The name *Carollia* was proposed by Gray in the Magazine of Zoology and Botany, conducted by "Sir W. Jardine, Bart. - P. J. Selby Esq., and Dr. Johnston," volume 2, page 488, 1838, which was, according to Sherborn's Index Animalium, published in the month of February. The Magazine of Zoology and Botany is not to be confused with the Annals of Natural History or Magazine of Zoology, Botany, and Geology conducted by the same editors with Sir W. J. Hooker and Richard Taylor, nor with the Magazine of Natural History conducted by Edward Charlesworth, all published in 1838.

In the Index Generum Mammalium by Palmer (North Amer. Fauna No. 23, p. 161, 1904) it is stated that *Carollia* Gray is preoccupied by *Carolia* Cantraine, a genus of mollusks, said to have been published in 1837, and so making necessary the use of the name *Hemiderma* Gervais, 1855.

Miller in 1924 (Bull. U. S. Nat. Mus. no. 128, p. 53) revived the name *Carollia* Gray on the basis that according to article 36 of the International Code of Zoological Nomenclature it was not a homonym of *Carolia* Cantraine, 1837.

An examination of the original reference to *Carolia* Cantraine shows that it was not published in 1837, but appeared in the Bulletin de L'Academie Royal des Sciences, et Belles-Lettres de Bruxelles, 1838, in volume 5, number 3, page 111, "Seance du 3 mars." As the name was proposed at the Seance on the third of March it must have been published some time later giving priority to *Carollia* Gray of February, 1838.

Uroderma bilobatum thomasi Andersen

Uroderma thomasi Andersen, 1900, Ann. Mag. Nat. Hist., ser. 7, vol. 18, p. 419.

Pucalpa: 1 male, Mar., 1947; Contamana: 1 male, 1 female, May, 1947.

These specimens are referred to *thomasi*, being intermediate between it and typical *bilobatum*. The total length of the skulls are 24–24.7 mm., and the tooth rows 8.1–8.5 mm.

Vampyrops zarhinus H. Allen

Vampyrops zarhinus H. Allen, 1891, Proc. Acad. Nat. Sci. Philadelphia, p. 400.

Pucalpa: 2 females, Feb., Mar., 1947.

The type locality of *zarhinus* is "Brazil." It has been recorded by Thomas (1901) from Para and by Vieira (1942) from the Rio Tapajoz. Thomas (1928*a*, *b*) listed specimens from Masisea on the Ucayali and Pebas on the Amazon. The Chicago Natural History Museum has one specimen from Yurimaguas, northern Peru, collected by Osgood. No adequate measurements have ever been published for the species so those on the specimens from Pucalpa are given here.

Measurements.—Forearm, 38.6 mm. Skull: greatest length, 20.6–21.6 mm.; condylo-basal length, 18–18.5; palatal length, 7.7–8.2; zygomatic width, 12; mastoid width, 9.9–10.7; width of braincase, 9.1–9.2; upper tooth row, 7.3–7.5; width across canines, 5.1–5.2; width across last molars, 8.5.

Artibeus jamaicensis aequatorialis Andersen

Artibeus jamaicensis aequatorialis K. Andersen, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 18, p. 421.

Agua Caliente: 3 females, Apr., 1946 (C.C.S.); Pucalpa: 1 male, Mar., 1947.

Artibeus lituratus lituratus Lichtenstein

Phyllostomus lituratus Lichtenstein, 1823, Verz. Doubl. Berlin. Mus., p. 3.

Agua Caliente: 3 females, Apr., 1946 (C.C.S.); Pucalpa: 2 males, 1 female, Feb., June, 1947.

These, and the preceding specimens of *Artibeus*, were taken together in a bat net stretched across a logging road.

Desmodus rotundus rotundus Geoffroy

Phyllostoma rotunda Geoffroy, 1810, Ann. Mus. Hist. Nat., Paris, vol. 15, pp. 181–186.

Yarinacocha: 2 males, 3 females, Mar., Apr., Sept., Nov., 1945–46; Pucalpa: 1 male, Jan., 1947.

While the author was visiting Sr. Schunke in March, 1946, these bats were attacking his chickens, and two were caught in a bat net stretched near the coop. Thomas did not record this vampire from the Ucayali.

Diaemus youngi cypselinus Thomas

Diaemus youngi cypselinus Thomas, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 288.

Yarinacocha: 1 male, Aug., 1946.

This race was described from one specimen collected at Pebas, Peru. It is said to differ from typical *D. youngi* by its longer wings. The specimen from Pucalpa has a slightly longer third finger than one from Venezuela, but this seems a rather weak character in view of the very few specimens known.

The references to these known specimens are:

Desmodus youngi Jentink, 1893, Notes Leyden Mus., vol. 15, p. 282, Berbice, British Guiana. One, the type.

Desmodus youngi, Thomas, 1900, Ann. Mus. Civ. Stor. Nat., Genova, ser. 2, vol. 20, p. 547, Palmeira, State of Parana, Brazil. One.

Diaemus youngi, Osgood, 1912, Field Mus. Nat. Hist., Zool. Ser., vol. 10, p. 63, El Panorama, Rio Aurare, Venezuela. One male.

Diaemus youngi, Thomas, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 289, Roco Nova, State of Parana, Brazil. Six (5 in Brit. Mus., 1 in U. S. Nat. Mus.).

Diaemus youngi, Vieira, 1942, Arq. Zool. Est. Sao Paulo, vol. 3, p. 380, Butantan, Sao Paulo, Brazil. Six.

Diaemus youngi cypselinus Thomas, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 21, p. 288, Pebas, Peru. One, the type.

This makes a total, with the present specimen, of 17 known examples, 13 from Brazil, 1 from British Guiana, 1 from Venezuela, and two from Peru.

Measurements.—(*youngi* from Venezuela followed by *cypselinus* from Peru). Forearm, 53.6, 55.2; third metacarpal, 52.9, 54.4; first phalanx of third finger, 9.7, 10.9; second phalanx of third finger, 27.3, 29.1; third phalanx of third finger, 13.4, 14.3; total length of third metacarpal and finger 103.3, 108.7. Skull: greatest length, 25.8, 26.3; condylo-basal length, 21.3, 22; interorbital width, 6.8, 6.9; zygomatic width, 14.3, 14.6; mastoid width, 13.2, 13.5; width of braincase, 13.8, 14; upper tooth row, 3.6, 3.4; across canines, 6, 6.3.

Diphylla ecaudata ecaudata Spix

Diphylla ecaudata Spix, 1823, Sim. Vesp. Bras., p. 68, pl. 36, fig. 7.

Yarinacocha: 2 males (1 alc.), 4 females, Jan., Mar., May, Oct., 1945–46.

This vampire has been recorded from the Departments of Amazonas, San Martin, and Loreto, Peru.

Myotis nigricans nigricans Maximilian

Vespertilio nigricans Maximilian, 1826, Beiträge z. Naturg. Brasil., vol. 2, p. 266.

Yarinacocha: 9 males, 12 females, Jan., Apr., Aug., 1946; Agua Caliente: 1 male, Apr., 1946 (C.C.S.); Cordillera Azul: 2 females, Aug., 1947.

Myotis albescens E. Geoffroy

Vesp[ertilio] albescens E. Geoffroy, 1806, Ann. Mus. d'Hist. Nat. Paris, vol. 8, p. 204.

Yarinacocha: 8 males, 10 females, July, 1945, Apr., 1946; San Jeronimo: 1 female, Apr., 1946 (C.C.S.).

A colony was discovered at San Jeronimo roosting in the roof of a low open-sided palm-thatched hut.

Myotis simus Thomas

Myotis simus Thomas, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 541.

Yarinacocha: 7 females (3 alc.), Mar., Apr., Aug., 1946.

These specimens were taken a short distance up river from the type locality at Sarayacu. The species is known from Ecuador (Miller and Allen, 1928) and from Para and Amazonas, Brazil (Vieira, 1942).

Eumops abrasus milleri Allen

Promops milleri Allen, 1900, Bull. Amer. Mus. Nat. Hist., vol. 13, p. 92.

Pucalpa: 1 male (skin only), Mar., 1947.

This specimen has been referred to *milleri* as the forearm measures but 56.5 mm. The subspecies has been recorded from the Rio Huallaga, but this is the first record for the Rio Ucayali.

Eumops trumbulli Thomas

Promops trumbulli Thomas, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, pp. 190–191.

Eumops perotis trumbulli, Sanborn, 1932, Jour. Mamm., vol. 13, p. 350.

Yarinacocha: 2 males, 2 females, May, 1946.

The small size (external and cranial) and the color (much lighter than in typical *perotis*) of these specimens agree so well with the original description of *trumbulli*, from Para, Brazil, that they will have to be referred to that species. When this author revised the genus (Sanborn, 1932*a*), *trumbulli* was considered a subspecies of *perotis*, based on small size due to

immaturity of specimens then available. These specimens, however, are fully adult and even smaller than the type of *trumbulli*, but differ in no other way.

Measurements.—Adult male and famale. Forearm, 72.2–70.4. Skull: greatest length, 29.5–28.6; condylo-basal length, 27.2–26.5; interorbital width, 5–5; zygomatic width, 16.7–16.4; mastoid width, 14.4–14.6; width of braincase, 13.1–12.9; upper tooth row, 11.1–11.2; width across canines, 7.3–6.7; width across last molars, 11.4–10.4; upper incisors, combined width at base, 3.1–2.9; upper canine, greatest diameter at base horizontally, 2.8–2.6; combined length of last premolar and first two molars, 7.3–7.

Molossus obscurus obscurus Geoffroy

Molossus obscurus E. Geoffroy-St. Hilaire, 1805, Bull. Soc. Philom., Paris, vol. 3, p. 279.
Yarinacocha: 5 males, 13 females, Jan.–May, Oct., Dec., 1945–1946.

Aotus trivirgatus trivirgatus Humboldt

Simia trivirgata Humboldt, 1809, Rec. Obs. Zool. Anat. Comp., vol. 1, p. 307.
Yarinacocha: 1 male, 3 females, Mar., Sept., 1946; Agua Caliente: 1 male, 1 female, Apr., 1946 (C.C.S.); Cerro Azul: 1 female, May, 1947.

Callicebus cupreus cupreus Spix

Callithrix cuprea Spix, 1823, Sim. Vesp. Bras., p. 23.
Yarinacocha: 1 male, 1 female, 3 skulls only, July, Oct., Nov., 1944–1946.

Pithecia monachus Humboldt

Simia monachus Humboldt, 1812, Rec. Obs. Zool. Anat. Comp., vol. 1, pp. 359, 362.
Cerro Azul: 1 male, 1 female, Mar., 1947.

Alouatta seniculus seniculus Linnaeus

Simia seniculus Linnaeus, 1766, Syst. Nat. ed. 12, p. 37.
Yarinacocha: 1 male, 1 female, 1 skull only, Dec., 1945, Feb., 1946; Cerro Azul: 2 males, 2 females, Apr., May, 1947; Cordillera Azul: 1 male, July, 1947.

Cebus apella macrocephalus Spix

Cebus macrocephalus Spix, 1823, Sim. Vesp. Bras., pp. 3–4.
Cerro Azul: 3 males, 2 females, Apr., May, 1947.

Saimiri boliviensis nigriceps Thomas

Saimiri boliviensis nigriceps Thomas, 1902, Ann. Mag. Nat. Hist., ser. 7, vol. 10, p. 246.
Yarinacocha: 7 males, Jan., Feb., Apr., May, 1946.

Ateles paniscus chamek Humboldt

Simia chamek Humboldt, 1812, Rec. Obs. Zool. Anat. Comp., vol. 1, p. 353.
Cerro Azul: 1 male, 3 females, Apr., 1947.

Lagothrix infumata Spix

Gastrimargus infumatus Spix, 1823, Sim. Vesp. Bras., pp. 41–42.
Cerro Azul: 1 male, May, 1947.

Marikina nigricollis nigricollis Spix

Midas nigricollis Spix, 1823, Sim. Vesp. Bras., pp. 28–29.
Yarinacocha: 2 males, May, 1946; Pucalpa: 1 male, 1 female, July, 1947.

Marikina devillei devillei Geoffroy

Hapale devillei Geoffroy, 1851, Comptus Rendus, Paris, vol. 31, p. 875.
Agua Caliente: 1 juv. female, Apr., 1946 (C.C.S.).
This specimen was a pet at the oil camp. None were seen wild during the stay at Agua Caliente.

Tamandua tetradactyla quichua Thomas

Tamandua tetradactyla quichua Thomas, 1927, Ann. Mag. Nat. Hist., ser. 9, vol. 19, p. 371.
Cerro Azul: 1 female, May, 1947.
Thomas described this almost pure black race from Yurac Yacu, Prov. Moyobamba, Dept. San Martin, Peru, and recorded other specimens from Chanchamayo and Pozuzo. The Chicago Natural History Museum has black specimens from Pozuzo, Hacienda Exito on the Rio Cayumba, Peru, and the upper Rio Jurua, Brazil. Thomas later (1928*a*) recorded a typically colored example from Chicosa, on the Rio Ucayali.

Sciurus igniventris igniventris Wagner

Sciurus igniventris Wagner, 1842, Arkiv. Naturgesch., vol. 1, p. 360.
Yarinacocha: 3 males, 4 females, Jan.–May, 1946; Agua Caliente: 1 male, Apr., 1946 (C.C.S.); Cordillera Azul: 1 male, Aug., 1947.

Sciurus ignitus irroratus Gray

Macroxus irroratus Gray, 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 431.
Yarinacocha: 4 males, Apr., June, 1946; Agua Caliente: 1 female, Apr., 1946 (C.C.S.).

Oryzomys laticeps nitidus Thomas

Hesperomys laticeps var. *nitidus* Thomas, 1884, Proc. Zool. Soc. London, p. 452.
Agua Caliente: 1 female, Apr., 1946 (C.C.S.).

Oryzomys longicaudatus destructor Tschudi

Hesperomys destructor Tschudi, 1844, Fauna Peruana, p. 182.
Yarinacocha: 3 males, May, Sept., 1945–1946; Pucalpa: 1 female, Sept., 1947.

Oryzomys (Oecomys) bicolor Tomes

Hesperomys bicolor Tomes, 1860, Proc. Zool. Soc. London, p. 217.
Yarinacocha: 1 male, 1 female, July, Aug., 1946.

Holochilus sciureus Wagner

Holochilus sciureus Wagner, 1842, Archiv. f. Naturgesch., vol. 8, p. 17.
Yarinacocha: 2 males, 4 females, Jan., Mar., July, Aug., Sept., Nov., 1945–1946.

Rattus rattus rattus Linnaeus

[*Mus*] *rattus* Linnaeus, 1758, Syst. Nat., ed. 10, vol. 1, p. 61.
Cordillera Azul: 1 female, Aug., 1947.
This specimen was collected at Cinchona, an experimental cinchona station on the road from Tingo Maria to Pucalpa. So far Sr. Schunke has not found any house rats at Pucalpa nor have they been recorded from there.

Mus musculus Linnaeus

[*Mus*] *musculus* Linnaeus, 1758, Syst. Nat., ed. 10, vol. 1, p. 62.
Yarinacocha: 1 male, Nov., 1945.

Myoprocta pratti Pocock

Myoprocta pratti Pocock, 1913, Ann. Mag. Nat. Hist., ser. 8, vol. 12, p. 110.

Cerro Azul: 1 female, May, 1947; Puerto Victoria: 1 male, Mar., 1923 (E. Heller).

The type locality is given as "Amazonas" Peru with another specimen from the Marona River. Ellerman (1940), who probably saw the type, gives the locality as Pongo de Rentema, Rio Marañon, Peru. Thomas (1928*b*) recorded a specimen from Iquitos. The specimens listed here increase the range well to the south.

The measurements for the Cerro Azul specimen are: External (by collector): total length, 400 mm.; tail, 50; hind foot, 85; ear, 32. Skull: greatest length, 79.8 mm.; condylo-incisive length, 68.5; interorbital width, 21.5; zygomatic width, 36.3; upper tooth row, 13.5; length of nasals, 23.9. The bullae are unfortunately broken.

Dasyprocta variegata variegata Tschudi

Dasyprocta variegata Tschudi, 1845, Fauna Peruana, p. 190.

Yarinacocha: 1 male (skull only), May, 1944.

Proechimys guyannensis brevicauda Gunther

Echimys brevicauda Gunther, 1876, Proc. Zool. Soc. London, pp. 748–750.

Yarinacocha: 1 male, 7 females, Mar., Apr., May, Sept., Oct., 1945–1946; Pucalpa: 1 male, June, 1947.

Mesomys ferrugineus spicatus Thomas

Mesomys ferrugineus spicatus Thomas, 1924, Ann. Mag. Nat. Hist., ser. 9, vol. 13, p. 535.

Yarinacocha: 2 males, 3 females, Mar., May, Aug., 1946.

The type locality of this race is Tushemo, near Masisea on the Ucayali. The species is also recorded from Contemana. Two of these specimens were collected by the author at night, one while running along a tree branch and the other while feeding on the fruit of a low tree.

Isothrix villosus villosus Deville

Lasiuromys villosus Deville, 1852, Rev. Mag. Zool., ser. 2, vol. 4, p. 360, pl. 15 (animal), pl. 16, figs. 5–5a (teeth).

Isothrix villosus molliae Thomas, 1913, Ann. Mag. Nat. Hist., ser. 9, vol. 13, p. 534.

Yarinacocha: 1 male, Mar., 1946.

The type locality of *villosus* is Sarayacu and that of *molliae* is Tushemo, near Masisea.

Echimys armatus rhipidurus Thomas

Echimys rhipidurus Thomas, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 285.

Yarinacocha: 4 males, 3 females, Jan., Mar., May, Aug., 1946.

This race, described from one specimen from Pebas, was said to be like *armatus*, but with the tail, except for the grizzled ochraceous basal two inches, "well clothed to the end with glossy black hairs, practically hiding the scales." In one of the series from Yarinacocha this is so, in two the hairs are black but do not hide the scales, and in the other four they are a light brown color. The underparts vary from brownish gray to light gray.

Measurements of the skulls are smaller than those given for the type, and the zygoma much lighter than those in *armatus* from French and British Guiana. These specimens might represent a slightly different race, but the variation in *rhipidurus* is not known and the material of *armatus* at hand is not adequate to come to any definite conclusions. The series is referred to *rhipidurus* for the time being.

Measurements.—External measurements by collector (type of *rhipidurus* in parentheses). Total length, 383–445 mm. (443); tail, 180–205 (203); hind foot, 31–37 (37.5); ear (16). Skull: greatest length, 49.7–54.1 (55.5); condylo-basal length, 43.2–47 (49.5); interorbital width, 11.5–14.6 (14.3); zygomatic width, 23.4–25.1 (26.5); width of braincase, 19.5–21.4; upper tooth row, 10–12.5 (14); length of nasals, 15.5–18.9 (18); least width of nasals, 4.2–4.7 (5).

Dactylomys dactylinus dactylinus Desmarest

Echimys dactylinus Desmarest, 1817, Nouv. Dict. d'Hist. Nat., 2nd ed., vol. 10, p. 57.

Yarinacocha: 1 female, Apr., 1946.

This appears to be the first specimen recorded from the Ucayali since Castelnau and Deville collected the species at Sarayacu in the 1850's. It is also one of few recorded specimens that can be considered typical of *dactylinus* Desmarest.

Measurements.—External (by collector). Total length, 320; tail, 430; hind foot, 65; ear, 17. Skull: greatest length, 79.5; condylo-basal length, 76.3; zygomatic width, 37.7; interorbital width, least, 21.5, greatest, 26.7; mastoid width, 28.9; upper tooth row, 20.3; length of nasals, 26.5.

Sotalia pallida Gervais

Delphinus pallidus Gervais, 1855, Castelanu, Voy., Mamm., p. 94.

Yarinacocha: 1 male (skull only), Mar., 1946.

In March of 1946 these dolphins were plentiful in Lake Yarinacocha, when their splashing and blowing was heard all during the night.

Nasua montana Tschudi

Nasua montana Tschudi, 1844–46, Fauna Peruana, p. 102, pl. 50.

Cordillera Azul: 1 male, Aug., 1947.

The older name for the Peruvian coati is used here until more material is available to definitely establish the characters and range of *N. n. mephisto* Thomas (1927), a black race described from Yurac-yacu, San Martin, with specimens from the Pachitea and Madre de Dios referred to it. The Chicago Natural History Museum has six trade skins from Pozuzo, three of which are black and could be called *mephisto* and three are light-colored and would have to be referred to *montana*. Melanism in coatis is so common that without other characters it would be difficult to ascribe a range to any locally named black race.

Potos flavus flavus Schreber

Lemur flavus Schreber, 1774–75, Die Saugeth., vol. 1, p. 188 (index of plates).

Yarinacocha: 3 males, Apr., 1946; Agua Caliente: 1 male, 1 female, Apr., 1946 (C.C.S.).

Bassaricyon alleni Thomas

Bassaricyon alleni Thomas, 1880, Proc. Zool. Soc. London, pp. 397–400, pl. 38, text fig. 1–3.

Yarinacocha: 1 female (with skeleton), Aug., 1946; Cerro Azul: 1 female, May, 1947; Agua Caliente: 1 male (alc.), Apr., 1946 (C.C.S.).

Described from Sarayacu, Rio Bobonazo, Ecuador, this mammal ranges in Peru south to Cusco. Thomas has recorded specimens from the departments of San Martin, Junin, and Cusco.

Eira barbara peruana Nehring

Galictis barbara var. *peruana* Nehring, 1886, Zool. Jahrb., Syst. Geog. Biol., vol. 1, p. 186.

Yarinacocha: 1 female, Apr., 1946; Cordillera Azul: 1 skull only, 1947.

Felis onca onca Linnaeus

Felis onca Linnaeus, 1758, Syst. Nat., ed. 10, p. 42.

Masisea: 1 skull only.

There is great disagreement over the recognition of the races of the jaguar. Nelson and Goldman (1933) described *F. o. ucayali* from Sarayacu. Pocock (1939) synonymized this with *onca*, but in the same paper referred a skull from Cerro Azul to *F. o. peruana* Blainville, although the status of that race he held to be unsettled.

Tapirus terrestris Linnaeus

Tapirus terrestris Linnaeus, 1758, Syst. Nat., ed. 10, p. 74.
Yarinacocha: 1 skull only, Oct., 1945.

Tayassu pecari pecari Link

Sus pecari Link, 1795, Beitr. Naturg., zweytes Stük, p. 104.
Yarinacocha: 2 skulls only, May, 1946.

LITERATURE CITED

ALLEN, G. M. 1935. Bats from the Panama Region. Jour. Mamm., vol. 16, pp. 226–228.

BARTLETT, EDWARD. 1871. Notes on the monkeys of Eastern Peru. Proc. Zool. Soc. London, pp. 217–220.

CABRERA LATORRE, A. 1907. A new South American bat. Proc. Biol. Soc. Washington, vol. 20, pp. 57–58.

ELLERMAN, J. R. 1940. The Families and Genera of Living Rodents. London. p. 196.

GERVAIS, PAUL. 1855. Anim. Nov. Rar. Castelnau L'Expéd. Amer. Sud., pp. 1–116, pls. 1–20.

GOODWIN, GEORGE G. 1942. A New *Pteronotus* from Nicaragua. Jour. Mamm., vol. 23, p. 88.

MILLER, GERRIT S., JR., AND GLOVER M. ALLEN. 1928. The American bats of the Genera *Myotis* and *Pizonyx*. U. S. Nat. Mus. Bull. 144, pp. 1–218.

NELSON, E. W., AND E. A. GOLDMAN. 1933. Revision of the jaguars. Jour. Mamm., vol. 14, pp. 221–240.

POCOCK, R. I. 1939. The races of jaguar (*Panthera onca*). Novit. Zool., vol. 41, pp. 406–422.

SANBORN, COLIN CAMPBELL. 1932*a*. The bats of the Genus Eumops. Jour. Mamm., vol. 13, pp. 347–357.

———— 1932*b*. Neotropical bats in the Carnegie Museum. Ann. Carnegie Mus., vol. 21, pp. 171–183.

———— 1937. American bats of the Subfamily Emballonurinae. Field Mus. Nat. Hist., Zool. ser., vol. 20, pp. 321–354.

THOMAS, OLDFIELD. 1901. On a collection of bats from Para. Ann. Mag. Nat. Hist., ser. 7, vol. 8, pp. 189–193.

———— 1920. Report on the Mammalia collected by Mr. Edmund Heller during the Peruvian Expedition of 1915 under the auspices of Yale University and the National Geographic Society. Proc. U. S. Nat. Mus., vol. 58, pp. 217–249, pls. 14–15.

———— 1924. On a collection of mammals made by Mr. Latham Rutter in the Peruvian Amazons. Ann. Mag. Nat. Hist., ser. 9, vol. 13, pp. 530–538.

———— 1927. On mammals collected by Mr. R. W. Hendee in the Province of San Martin, N. Peru, mostly at Yurac Yacu. *Ibid.*, ser. 9, vol. 19, pp. 361–375.

———— 1928*a*. The mammals of the Rio Ucayali. *Ibid.*, ser. 10, vol. 2, pp. 249–265.

———— 1928*b*. On mammals obtained by Mr. Hendee at Pebas and Iquitos. *Ibid.*, ser. 10, vol. 2, pp. 285–294.

VIEIRA, CARLOS O. DA CUNHA. 1942. Ensaio Monográfico sobre os Quiropteros do Brasil. Arq. Zool. Est. São Paulo, vol. 3, art. 8, pp. 219–471, pls. 1–4, text figs. 1–42.

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STATUS OF NAMES CREDITED TO OKEN, 1816

By Philip Hershkovitz

Names in Oken's "Lehrbuch der Zoologie" (or "Lehrbuch der Naturgeschichte"), published in 1816 in Jena, are non-Linnaean and not available in scientific nomenclature. Current citations of names credited to Oken are, for the most part, gross distortions of the original form and systematic position of corresponding names in Oken's "Lehrbuch." Improper use of names credited to Oken dates chiefly from J. A. Allen (Bull. Amer. Mus. Nat. Hist., vol. 16, pp. 373–379, 1902), and from Palmer ("Index Generum Mammalium," North Amer. Fauna No. 23, 984 pp., 1904).

In his review of Oken's "Lehrbuch," Allen (*op. cit.*, p. 373) noted that "account has been taken of some of the names first proposed in it, and when found to have priority they have been adopted; a few others quite as well entitled to recognition appear to have been overlooked." Allen then expressed the following critique. "Oken was almost as erratic and irregular in nomenclatorial matters as Zimmermann in his 'Specimen Zoologiae Geographicae,' published in 1777, but in some respects is less satisfactory, since he failed to cite authorities for the names used, and gave no references to his sources of information. Both diagnosed generic, subgeneric and other groups, as well as species, under vernacular or systematic names, as seemed to please their fancy, and employed the names given by previous authors as these authors used them, regardless of whether the generic portion of the name conformed or not to the genus to which they assigned the species." In spite of this clear indictment of Oken's system, Allen was inclined to accept some of his names. Allen then discussed eleven terms from the "Lehrbuch," nine of which he judged available as generic names for mammals.

Palmer followed Allen by listing no less than twenty-seven Oken names in his "Index Generum Mammalium." For some names in the "Lehrbuch," Palmer cited first the index page, in Roman numerals, followed by the text page, in Arabic numerals. This reverse order of the real sequence in which the names appear in the "Lehrbuch" is misleading. Any one of a number of names on the text page of the "Lehrbuch" cited by Palmer is preoccupied on an earlier page of the "Lehrbuch" where the same name is used either in an entirely different sense or for an entirely different animal.

The German systematist, Matschie (Sitz.-Bericht Gesselsch. naturf. Fr. Berlin, No. 4, p. 55, 1904), appears to have been the first to react against the use of Oken names in mammalian nomenclature. Matschie summarily stated that "Die in Oken's Lehrbuch der Naturgeschichte verwendeten Bezeichnungen dürfen deshalb nicht gebraucht werden, weil die Grundsätze der binaeren Nomenklatur in diesen Buche nicht befolgt sind."

Stiles and Orleman (Hygienic Lab. Bull. No. 145, Health Serv., Treasury Dept., Washington, D. C., p. 29, 1927) peremptorily rejected Oken's "Pan" for the chimpanzee. They pointed out that from their viewpoint "the nomenclature used by Oken, 1816, pp. 1223–1232, is not in harmony with International Rules, is neither consistently binary nor consistently binomial, hence is not

available under the Law of Priority. A cursory glance at his classification seems to negative this interpretation; but when his groups are tabulated it is seen that while he divides genera into subgenera, subgenera into species, and species into various subdivisions (some difficult of interpretation), his method of writing binomials (subgenera and species) and his confusion in citing *Simia* and 'Simius' as generic name in various places are not in harmony with the customs of Linné, with the custom of Oken's day, or with the International Rules; it is a nomenclature *sui generis*, which in many instances is difficult of interpretation, and in the interest of science it should not be recognized."

In 1932, Cabrera (Trab. Mus. Cienc. Nat. Madrid, zool. ser. No. 17, p. 106) firmly dismissed Oken's names. In a later publication, Cabrera (Ciencia, Mexico, vol. 4, pp. 108–111, 1943) elaborated his argument by conclusively proving that on the basis of all concepts of the Linnaean system of Nomenclature, Oken's names are not available.

Oken's system of nomenclature, if it may be called a system, defies fine analysis. What may be said to be the system employed by Oken in classifying one section of the Mammalia or other class of animals, does not apply to any other section of the same Class. What appear in the "Lehrbuch" to be equal subdivisions of the Class Mammalia, are hardly ever consistently equal in rank or comparable in terminology. One of Oken's "Gattungen" could be equivalent to any hierarchy from species upward as compared with other subdivisions of his own system or with the systems of his contemporaries. The names of Oken's orders, families, genera, and their subdivisions are couched in vernacular, technical or purely descriptive terminology. The name might be uninominal or multinominal irrespective of hierarchy.

The name Oken assigned to each of his species ("Art") was either a vernacular name, a technical name, or a combination of both kinds. The name or combination of names selected for a species was often all names believed by Oken to have been applied by others. Thus, species 12 (p. 736) of the "Geisgemsen" is called simply, "*C. Colus, scythica, Saiga, Capra tatarica, Ibex imberbis, Strepsiceros*, Suhak, ungerischer Bock."

As a rule, classical and other non-Germanic vernacular names were printed in the "Lehrbuch" in the same type as Latin technical names. Some of these vernacular names are currently masquerading as generic names dated from Oken. To some extent, Oken followed Brisson's uninominal system for specific names. He frequently abbreviated such uninominals as, for example, *V.* [= *Canis vulpes*] and *P.* [= *Felis pardalis*] when they were combined with other specific, varietal, or vernacular names. One form of this last example of a uninomial specific name has undergone an astonishing metamorphosis in the hands of certain authors. It is currently cited as genus *Panthera* Oken!

Duplications of names under different "generic" headings is also common in the "Lehrbuch." The "Gattung *Cervus*" introduced on page 746 includes many species, judged by their names and descriptions, already assigned by Oken to his *Capra* (p. 734) or his *Cemas* (p. 727). Multiplication of individual technical names, but in different combinations, is the rule rather than the exception with

Oken. The name *Strepsiceros*, for example, appears in the following combinations:

[p. 722] "2. Art. *O[vis] strepsiceros.*
[p. 732] 6. Art. *C[apra] Strepsiceros et Addax Pl., Cervicapra, Gazella indica*, Antilope.
[p. 733] 7. Art. *C[apra] Kuhdu, Strepsiceros, Cervus capensis*, Kuhdu Kuhesel (Kondome aus Bock ohne Name?), wilde Ziege.
[p. 736] 12. Art. *C. Colus, scythica, Saiga, Capra tatarica, Ibex imberbis, Strepsiceros*, Suhak, ungerischer Bock."

Oken had no fixed concept of what constitutes a specific name as understood today and in his own day. There can be no doubt, however, that he intended his multinominals, such as the above examples, to be the *name*. This concept is illustrated by the following examples from the "Lehrbuch:"

[p. 1146] "6. Art. *Did[elphis] cancrivora.*
* Crabier (nicht *D. marsupialis, Philander maximus orientalis, Canis ferus major, Cancrosus, Koupara*)."

Thus, the "Crabier" is not simply "nicht *D. marsupialis*," presumably of Linnaeus, but "*D. marsupialis*" plus the other names cited. Otherwise, it would be confused with another species listed as (p. 1150) "*Philander maximus, orientalis, foemina* (*Did. marsupialis, Phil. amboinensis*)." This "*Philander*" etc. is of course not the same as (p. 1149) "*Philander Opossum, sive Carigueja, Brasiliensis*, (*Did. Opossum*)."

Below is given an analysis of names credited to Oken as they appear in Palmer's "Index Generum Mammalium" compared with their real status in the text of the "Lehrbuch." Each of the "Oken" names discussed is followed by an attempt to indicate a valid pertinent generic name.

Oryx, Palmer (Index Gen. Mamm., 1904, pp. 485, 793; cited from Oken's "Lehrbuch," pp. 672–673, 1816).

"Apparently a new name for the Narwhal (*Monodon* Linnaeus, 1758, and *Ceratodon* Brisson, 1762). Type: *Monodon monoceros* Linnaeus," (Palmer, *supra cit.*).

On page 672 of the "Lehrbuch," "Oryx" appears as, "2. Gattung. *Oryx*, Nahl, *Monodon, Ceratodon*, Seeinhorn; . . . " The name "*Oryx* für Narwal" is first mentioned on page 665 of the "Lehrbuch." It is used again in the following combinations:

[p. 734] "10. Art. *C[apra] Oryx Oppian, Leucoryx*, weise G. [= Gems or Gazelle?] . . .
[p. 735] 11. Art. *C. Alces, Oreas, Oryx*, Elenngems, Kapisches Elenn, Poffo, Empophos, Cann, Canna (nicht Kudu); . . .
[p. 741] 23. Art. *C. Pasan, Ant. Oryx, Gazella, bezoartica*, Pasan, Gemsbock; . . . "

Remarks.—Names from the "Lehrbuch" cited by Palmer as generic are not consistently equivalent to generic names as understood at any time since the adoption of the Linnaean system of nomenclature. Many of Oken's names, as originally proposed, cannot even be construed as technical names.

Valid pertinent names: *Monodon* Linnaeus, 1758, for *Monodon monoceros* Linnaeus; and *Oryx* Blainville, 1816, for *Antilope oryx* Pallas [= *Capra gazella* Linnaeus]. Oken's "*Oryx*" has not been used by authors.

Cetus, Palmer (Index Gen. Mamm., pp. 176, 794; cited from Oken, pp. 674–678). According to Palmer (p. 176), preoccupied by *Cetus* Brisson, 1762.

Remarks.—Oken's "*Cetus*" is not in current usage and requires no further discussion here.

Valid pertinent name: *Cetus* Wagler, 1830, is available. Brisson's names are questionably

valid and should not be used unless officially declared available by suspension of the Rules of Zoological Nomenclature.

Myopterus, Palmer (Index Gen. Mamm., pp. 440, 800; cited from Oken, pp. 932–933).

According to Palmer (p. 440), the name is preoccupied by *Myopterus* Geoffroy, 1813, and needs no further discussion.

Lupus, Palmer (Index Gen. Mamm., pp. 387, 825; cited from Oken, pp. 1039–1040).

According to Palmer, a subgenus of *Canis*. This status is not evident in the "Lehrbuch." Oken's classification shows the name treated as follows:

[p. 1037] "Schakale.

[p. 1038] 4. Art. *Thos vulgaris, C. aureus, flavus, Lup[us] aureus, Thos, Adive, Adil, Squillachin*, wilder indischer Hund, Schakal, Goldwolf; . . .

[p. 1039] Wölfe.

1. Art. *C. surinamensis, Thous*; . . .

2. Art. *Lupus vulgaris, C. Lupus*, Wolf; . . . "

Remarks.—According to Allen (*op. cit.*, p. 377) the names *Vulpes* and *Lupus* "are used in combination with specific names and correspond to superspecific divisions of his [Oken's] *Canis*, but are not employed in a manner that entitles them to recognition in nomenclature. Brisson and Oken are strictly comparable in their use of these names, which are not tenable from either of these authors." Allen's conclusion is better than his interpretation. It will be noted, also, from the above examples that "*Lupus*" Oken, page 1039, cited by Palmer, with "*Lupus vulgaris*" as type, if it were so selected, becomes a homonym of "*Lupus*" Oken of page 1038 with "*Lup[us] aureus*" type by monotypy. This last "*Lupus*" is, in turn, an absolute synonym of Oken's "*Thos*." The name *Lupus* is not currently used but is available from authors other than Brisson, Frisch, and Oken.

Vulpes auctorum, currently cited from Oken, p. 1033.

Palmer (Index Gen. Mamm., p. 708) dated *Vulpes* from Frisch, 1775, (a non-Linnaean work) and from Skjöldebrand, 1777, with "Type: *Vulpes minimus saarensis* Skjöldebrand (= *Canis cerdo* Gmelin, 1787)." Miller (Cat. Mamm. West. Europe, p. 325, 1912) dated *Vulpes* from the "Lehrbuch," (pp. 1033, 1034, index p. 1268) with type "*Vulpes communis* Oken = *Canis vulpes* Linnaeus." Miller's "*communis*" being, no doubt, a *lapsus calami* for Oken's "*vulgaris*" as shown in the following tabulation of Oken's classification.

[p. 1032] "2. Gatung. *Megalotis*, Fennec, Zerd;

1. Art. *M. Cerdo, Vulpes minimus Zaarensis, Viverra aurita*, gem. Z.; . . .

3. Gattung. *Canis*, Hund; . . .

[p. 1033] a. Füchse; . . .

* Graue.

1. Art. *V. arctica, C. Lagopus, Isatis, V. alba*, Eisfuchs, Steinfuchs, Polarfuchs; . . .

b. *V. fuliginosa*; . . .

c. V. groenlandica; . . .

2. Art. *V. antactica, indica*, Wolffuchs, Coyotl.; . . ;

b. *C. culpaeus*, Culpeu; . . .

3. Art. Griesf., *V. cinereo-argentea*; . . .

[p. 1034] 4. Art. *V. virginiana, cinerea*, grauer F.; . . .

5. Art. *V. argentea*, Silberf.; . . .

* Rothe

6. Art. *V. bengalensis*; . . .

7. Art. *V. vulgaris, C. Vulpes*, Fuchs, Räf, Reisnek, Renard; . . . "

Remarks.—Impossible as it is to apply rules of nomenclature to Oken's system, the above extract from the "Lehrbuch" lends itself to some sort of analysis based on accepted procedure in determining the status of a generic name as determined by its genotype. Thus, whether

or not the "Gattung *Megalotis*" Oken (p. 1032) is equivalent to a genus as understood today, it is equal in rank to Oken's subdivision "Gattung *Canis*." Hence, the first and only species of "*Megalotis*" Oken, "*M. cerdo, Vulpes minimus Zaarensis* [Skjöldebrand]" automatically preoccupies Oken's later use of "V[ulpes]." Furthermore, Oken's "Vulpes" listed on index page 1268 refers to "*Vulpes minimus Zaarensis*," on page 1032 of the text. As a matter of fact, "*Vulpes*" as employed by Oken may be interpreted as either the pre-Linnaean classical term for fox or as a monomial specific name for any fox or fox-like canid. J. A. Allen (Bull. Amer. Mus. Nat. Hist., vol. 16, p. 377) rejected "Vulpes" Oken and "Lupus" Oken as "not employed in a manner that entitles them to recognition." Palmer, apparently followed Allen with respect to "*Vulpes*" Oken. As the matter stands now, "*Megalotis*" Oken = *Fennecus* Desmarest which, in turn by virtue of the name of its genotype, *Vulpes minimus Zaarensis* Skjöldebrand, should become *Vulpes* Skjöldebrand. With Skjöldebrand's questionably valid name dropped, (*cf.* G. M. Allen, Bull. Mus. Comp. Zool., vol. 83, pp. 188–9, 1939). *Fennecus* can be retained for the fennecs and the earliest valid use of *Vulpes* for the common fox becomes available.

Valid pertinent name: Vulpes Fleming, Philosophy of Zoology, Edinburgh, vol. 2, p. 184, 1822 (the common fox); History of British Mammals, p. 13, 18[illegible]; monotypic genotype, *V. vulgaris* = *Canis vulpes* Linnaeus. *Vulpes* Skjöldebrand, 1777, is a *nomen inquirendum*, its genotype presently included in *Fennecus* Desmarest 1804. Valid use of *Vulpes* dated prior to Fleming may be found. In any case, usage makes desirable, if not almost mandatory, retention of *Vulpes* for the common fox.

Thos, Palmer (Index Gen. Mamm., pp. 676, 826; cited from Oken, pp. 1037–1039).

Erroneously interpreted by Palmer as a subgenus of *Canis*. Genotype designated by Allen (*op. cit.*, p. 377) as "*Thos C[anis] ceylonensis* Oken (= *Canis aureus* Linn., part)."

Remarks.—Oken's listing of the name (p. 1038) is shown in the above discussion of *Lupus*. "*Thos*," as used by Oken, may be translated into modern systematics as a generic, a specific, a pre-Linnaean classical, and a vernacular name, according to the interpreter. Allen's opinion regarding the status of "Lupus," quoted above, applies equally to "Thos."

Valid pertinent name: According to Cabrera (Trab. Mus. Nac. Cienc. Nat., Madrid, zool. ser. no. 57, p. 106, 1932), *Vulpicanis* Blainville, 1837.

Pusa, Palmer (Index Gen. Mamm., pp. 598, 833; cited from Oken, pp. 986–987).

"Type: *Pusa orientalis* (=*Mustela lutris* = *Lutra marina*) . . . Name preoccupied by *Pusa* Scopoli, 1777, a genus of Phocidae."

Listed in the "Lehrbuch" as follows:

[p. 985] "3. Gattung. *Pusa, Lutra marina*; . . .

[p. 986] 1. Art. *Lutra gracilis*; . . .

2. Art. *P. orientalis, Mustela Lutris, Lutra marina*, Seeotter, Kaiko; . . . "

Remarks.—Oken's "*Pusa*" is a vernacular name for *Lutra marina*. Oken followed no consistent plan in the sequence of vernacular, pre-Linnaean classical and technical names. Furthermore, the difference between Oken's technical, classical, and non-Germanic vernacular names is obscured by the fact that all may be printed in the same type and all abbreviated to only the initial letter.

Valid pertinent name: Lataz Gloger, 1827.

Grison, Palmer (Index Gen. Mamm., pp. 300, 831; cited from Oken, pp. xi, 1000–1001).

"Type: *Viverra vittata* Gmelin."

It is Palmer, not Oken, who credited Gmelin as the author of the name *Viverra vittata*. Oken cited neither author nor bibliographic references to names previously established in the literature. Reproduced below is the pertinent part of Oken's classification of the mustelids, with the text description of each category or named form omitted.

[p. 991] "5. Sippschaft. Reiherklauer—Vager.

1. Gattung. Muffer; . . .

a. Dachse; . . .

a. *Meles*, Dachs; . . .
[p. 993] b. Stunk, *Mephitis*, *Viverra*, Stinkthier, Muffet; . . .
[p. 994] 1. Art. Zweistreifiger St[unk]; . . .
a. Teufelskind oder Stinkthier (*Viv. Mephitis*); . . .
b. Yaguare, *Zorillo*, Muffet von Chili; . . .
[p. 995] c. *Gulo quitensis*, Atok oder Zorra (Fuchs); . . .
2. Art. Fünfstreifiger St[unk]; . . .
a. *Putorius americanus striatus* (*Viv. Putorius*); . . .
[p. 997] c. *Conepate* (*Viv. Putorius*); . . .
3. Art. Einstreifiger St.; . . .
a. *Cinche* (*Viv. Mephitis*); . . .
b. *Mapurito* (Viv. Mapurito); . . .
[p. 999] c. Iltist.; . . .
1. Art. Gefleckter St[unk]; . . .
a. *Mapurito* oder *Mafutiliqui* (*Viv. Zorilla*); . . .
b. *Chingha* (*Viverra Chingha*), . . .
[p. 1000] c. *Zorille*, . . .
d. Gräving, *Grison*, . . .
1. Art. Zügel G.; . . .
a. *Chinche* (*Viv. vittata*), . . .
b. *Viverra vittata*, *Grison*, . . .
[p. 1001] *Mustela gujanensis*, *Foina* von Güana;
Huron minor, *Martes Grison*; . . .
e. Schnopp, *Tayra*; . . .
1. Art. Gelbkehliger Sch[nopp].; . . .
a. *Mustela barbara*, Tayra oder gross Wiesel; . . .
Einerlei Gr[ison] Marder von Güana, *Must. poliocephalus*.
b. *M[ustela] lanata*, Kl. *Foina* von Güana; . . .
c. *Mustela canadensis*, Pekan; . . .
[p. 1002] *Huron major* (*Furo m.*), *Martes Tayra*, . . .
2. Art. Schwarzer Sch[nopp].
a. *Yzquiepatl*, *seu Vulpecula quae Maizium torrefactum aemulatur colore* (*Viv. Vulpecula*); . . .
[p. 1003] b. Stinkhier (*Viv. Putorius*), . . .
[p. 1007] 2. Gattung. Hiller; . . .
a. *Zibetha*, Zibeth; . . .
1. Art. *Z. orientalis*, *Viv. Zibetha*, *Felis Z.*, *Hyaena odorifera*, *Zibet.*; . . .
p. 1009] 2. Art. *Z. africana*, *Viv. Civetta*, *Hyaena*, *Felis Zibethi*, *Civette*; . . .
3. Art. *Mustela moschata*; . . .
p. 1010] 4. Art. *V. Hermaphrodita*; . . .
b. *Genetta*, Genithe, Ginst, Ginster Katze; . . .
1. Art. *Viverra Genetta turcica*; . . .
2. Art. *V. G. hispanica*, *gallica*, *Pilosello*; . . .
3. *V. Fossa*, *Fossane*; . . . "

Remarks.—"*Grison*" was not proposed by Oken as a generic name. If Palmer's interpretation of Oken's "Gattung *Pusa*" is momentarily accepted as a generic name, then Oken's "Gattung Muffer" is also a "generic" name, with "*Grison*" included somehow. "*Grison*" appears on page 1000 of the "Lehrbuch" as the French equivalent of Oken's Germanic "Gräving" and then very clearly as the vernacular for *Viverra vittata*. Finally, Oken [p. 1001) used *Grison* in combination with *Martes* in what may be translated as a trivial technical name.

Valid pertinent name: Galictis Bell, 1826.

Mapurito, Palmer (Index Gen. Mamm., pp. 399, 832; cited from Oken, pp. 997–999). "Type: *Viverra mapurito* Gmelin, from Pamplona, New Granada."

Remarks.—Oken gave no authority for the name "*Mapurito*" though it is evidently based on *Viverra mapurito* Mutis. Palmer's selection of authors of genotypes is arbitrary. As shown in Oken's classification (see **Grison**, above), "*Mapurito*" is a native name for both *Viverra mapurito* (p. 997) and *Viverra zorilla* (p. 999). Recognition of "*Mapurito*" as a generic name illustrates Palmer's inconsistent method of extracting terms from Oken's text without regard to hierarchies. "*Mapurito*" is listed in the "Lehrbuch" within a subspecific category. "*Grison*," where cited by Palmer, is a superspecific category, and "*Oryx*" and "*Pusa*," where cited by Palmer, are supergeneric categories.

Valid pertinent name: Conepatus Gray, 1837. Note that Oken used the name "*Conepate*" as the vernacular equivalent for a part of *Viverra Putorius*. This name was not adopted by Palmer though its status is identical with those of "*Mapurito*," "*Cinche*," "*Chingha*," etc.

Tayra, Palmer (Index Gen. Mamm., pp. 666, 833; cited from Oken, pp. xi, 1001).

"*Mustela barbara* Linnaeus (type)."

Remarks.—In the "Lehrbuch," (see **Grison**, above), "*Tayra*" is first (p. 1001), the native equivalent for the German term "Schnopp," second, the vernacular for *Mustela barbara*, and third, a trivial name in combination with *Martes*. At the same time, "*Martes Tayra*" Oken (p. 1002) is susceptible to being interpreted as a duplicate or synonym of "*Huron major*" Oken. However, no device has yet been discovered that permits a uniform interpretation of Oken's system of nomenclature. Many of the mustelids included in the "Gattungen" "Muffer" " and "Hiller" on pages 991–1007 of the "Lehrbuch" are listed again in the "Gattung. *Mustela*" on pages 1025–1031. On page 1031, "*M*[*ustela*]. *poliocephalus* (*cf.* p. 1001) is redescribed and said to be "*Must*[*ela*] *barbara*."

Valid pertinent name: Eira H. Smith, 1842. *Galera* Browne, 1789 (*ex* Palmer, p. 289), was offered by Simpson (Bull. Amer. Mus. Nat. Hist., vol. 85, p. 113, footnote 4, 1945) as an earlier name. It was properly shown by J. A. Allen (*Ibid.*, vol. 24, pp. 586–589, 1908) that Browne's 1789 *opus* is merely a second edition of Browne's "Civil and Natural History of Jamaica," a pre- and non-Linnaean work published in 1756. Hence Browne's *Galera* dates from 1756 and is not available. Furthermore, Browne's *Galera* is a mongoose brought to Jamaica from Africa.

Zorilla [*sic*] Palmer, (Index Gen. Mamm., pp. 716, 833; cited from Oken, pp. xi, 1000).

"Type: *Viverra zorilla* Erxleben."

Remarks.—"*Zorille*" Oken (p. 1000) is a vernacular name. "*Zorilla*" Oken (p. xi, index, back part of book) is a misprint and refers to "*Zorille*" on page 1000. For Oken's treatment of "*Zorille*," see classification under **Grison** above.

Valid pertinent name: Zorilla Geoffroy, 1826.

Genetta, Palmer (Index Gen. Mamm., pp. 292, 839; cited from Oken, pp. 1010–1012).

"Subgenus of *Viverra*."

Remarks.—As listed in the "Lehrbuch" (see **Grison**, above) "*Genetta*" is either a technical or, more probably, a vernacular name for a superspecific category. The name as it appears among the "Arten" can be interpreted as either subgeneric or specific. Whatever it may be, the only reward for any attempt to align Oken's names in accordance with hierarchies developed from the Linnaean system is confusion.

Valid pertinent name: Genetta Cuvier, 1817.

Zibetha, Palmer (Index Gen. Mamm., pp. 715, 841; cited from Oken, p. 1007).

"Species: *Zibetha orientalis* Oken (= *Viverra zibetha* Linnaeus), from India; and *Z. africana* Oken (= *Viverra civetta* Schreber), from Africa."

Remarks.—For Oken's treatment of the species, see discussion under **Grison.**

Valid pertinent name: Viverra Linnaeus, 1758, for *V. zibetha;* and *Civettictis* Pocock, 1915, for *V. civetta* Schreber.

Viscaccia, Palmer (Index Gen. Mamm., pp. 707, 845; cited from Oken, pp. 835–837).

In the "Lehrbuch," a subdivision of "Murzer" and evidently intended to be the native name for chinchillas in general. Included species are:

[p. 836] "1. Art. *Lepus chilensis*, . . .

[p. 837] 2. Art. *Mus laniger, Chinchilla*, Wollmaus; . . ."

Valid pertinent name: Lagidium Meyen, 1833, adopted in preference to *Viscaccia* Oken, by suspension [!] of the Rules (Opinion 110, Inter. Comm. Zool. Nom., 1929). This action is a sad commentary on the competence of the then International Commission. *Lagidium* Meyen *is* the earliest valid generic name for the viscaccia and neither an Opinion nor suspension of the Rules is required for its recognition. On the other hand, the Rules categorically proscribe names proposed by Oken and other non-Linnaean authors. Only by unilateral suspension or through ignorance of the Rules are such names introduced as valid into scientific literature.

Mussascus, Palmer (Index Gen. Mamm., pp. 436, 856; cited from Oken, p. 886).

"New name for *Ondatra* Link, 1775; and *Fiber* Cuvier, 1800."

Citellus, Palmer (Index Gen. Mamm., pp. 190, 864; cited from Oken, pp. x, 842–846).

"Species: *Arctomys citellus* (Linnaeus, type), . . ."

Treated as follows in the "Lehrbuch":

[p. 842] "3. Krietsche

a. *Citellus, Ceacodyli*?, Zisel, Zitsian, Bilch; . . .

1. Art. *Arct. Citellus, Mus noricus, ponticus, Cricetus orientalis, Zisel*, Suslik, gefleckes Murm.; . . ."

Valid pertinent name: Spermophilus Cuvier, 1825. Rejection of this erstwhile well-known and universally used name in favor of Oken's ambiguity was unconscionable.

Monichus, Palmer (Index Gen. Mamm., pp. 430, 895; cited from Oken, pp. xi, 1208–1211).

Type fixed as *Simia mona* Schreber, by J. A. Allen (Bull. Amer. Mus. Nat. Hist., vol. 47, p. 350, 1925).

Valid pertinent name: Cercopithecus Brünnich, 1772, genotype *Simia mona* Schreber.

Sylvanus, Palmer (Index Gen. Mamm., pp. 654, 896; cited from Oken, pp. 1223–1225).

"New name for *Inuus* Geoffroy, 1812 . . . Name preoccupied by *Sylvanus* Latreille, 1807, a genus of Coleoptera."

Psilodactylus, Palmer (Index Gen. Mamm., pp. 594, 897; cited from Oken, pp. xi, 1164–1165).

Type: *Psilodactylus madagascariensis* (= *Sciurus madagascariensis* Gmelin)."

Valid pertinent name: Daubentonia E. Geoffroy, 1795.

Faunus, Palmer (Index Gen. Mamm., pp. 284, 902; cited from Oken, pp. xi, 1227–1230).

"Type: The Orang utan, *Faunus indicus* (= *Simia satyrus* Linnaeus). . . . Name preoccupied by *Faunus* Montfort, 1810, a genus of Mollusca."

Valid pertinent name: Pongo Lacépède, 1779.

Pan, Palmer (Index Gen. Mamm., pp. 508, 902; cited from Oken, pp. xi, 1230–1232).

"Type: *Pan africanus* Oken (= *Simia troglodytes* Gmelin)."

Valid pertinent name: Chimpansee Voigt, Cuvier's Das Thierreich, vol. 1, p. 76, 1831.

Satyrus, Palmer (Index Gen. Mamm., pp. 619, 902; cited from Oken, pp. xi, 1225–1227).

"New name for *Hylobates* Illiger, 1811. . . . Name preoccupied by *Satyra* Meigen, 1803, a genus of Diptera."

Cemas, Palmer (Index Gen. Mamm., pp. 167, 916; cited from Oken, pp. 727–744).

"Type: *Cemas gnu* Oken (= *Antilope gnou* Zimmermann)."
Valid pertinent name: Connochaetes Lichtenstein, 1814.

Pecus, Palmer (Index Gen. Mamm., pp. 518, 919; cited from Oken, pp. 711–712).
"Includes 5 groups or subgenera; *Bos*, *Ovis*, *Capra*, *Cemas*, and *Orasius*."
Remarks.—Palmer's treatment of "Pecus" as a generic name is confounding. The name is not in current use and need not be discussed.

Orasius, Palmer (Index Gen. Mamm., pp. 478, 926; cited from Oken, pp. 744–745).
"Type: *Cervus camelopardalis* Linnaeus."
In the "Lehrbuch," "*Orasius*" is the pre-Linnaean classical name for the giraffe, it appears as follows:
[p. 744] "e. *Orasius*, Giraffe; . . .
[p. 745] 1. Art. *Orasius*, *Cervus camelopardalis*, Giraffe, Ghiamala, Zuraphate; . . . "
Remarks.—Palmer's unreasonably forced interpretation of the above is to the effect that Oken intended the name to be *Orasius camelopardalis*.
Valid pertinent name: Camelopardalis Schreber, 1784. *Ovifera* Frisch, 1775, is not available.

Panthera, Palmer (Index Gen. Mamm., p. 509; cited from Oken, pp. 1052–1066).
Type: "*P*[*anthera*] *vulgaris*" = *Felis panthera* Pallas = *F. pardus* Linnaeus, as selected by J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 16, p. 378, 1902.
The section of the "Lehrbuch" where the names "*Panthera*," "*Tigris*" and "*Leo*" are mentioned, is reproduced below but with the text descriptions of each named form omitted.
[p. 1052] "2. Pardel, Lunzen; . . .
a. Geschmitzt.
1. Art. *Panthera*, *F. colocolo*; . . .
b. Gestriemt, wie Ströme.—*F. Pardalis.*
2. Art. *P.* [= *Pardalis*, or *Panthera*?] *paragayensis*; . . .
[p. 1053] **Ocelot*; . . .
*Chibi-guazu; . . .
[p. 1054] c. Geflammt.—*F. Pardalis.*
3. Art. *P.* [certainly *Pardalis* is intended] *mexicana*; . . .
**Tlaco-Ozelotl*, *Tlal-Ocelotl*, *Catus-Pardus mexicanus*, *Panthera americana*;. . .
[p. 1055] **Jaguar* (ist *Tlaco-Ocelotl*), *Chat-tigre*; . . .
[p. 1056] 4. Art. P[ardalis] F[elis] cinerea; . . .
5. Art. P. alba, F. uncia; . . .
**Once* (*Uncia*, *Leuncia*, *Lynx*), *Phet*, *Faahd* (in Barbarei), kleines afrik. Tigerfell; . . .
[p. 1057] d. Geäpfelt oder gerost.—Eigentliche Panther
6. Art. P. [= Pardalis or Panthera?] *varia*, *F. Leopardus*; . . .
**Leopard*, Tigerfell; . . .
[p. 1058] 1. Afrikanischer L., *F. Leopardus*, *Uncia*, *Leopard*, grosser L.; . . .
2. Ostindischer, kleiner L.; . . .
3. Bengalischer, schwarzer L.; . . .
e. Geringelt—Aechte Panther.
7. Art. *P.* [= *Pardalis*] *vulgaris*, *Panthera*, *F. Pardus*, *Pardalis* oder ächter Panther, *Varia et Pardus*; . . .
[p. 1059] **Panthère*, *Pardalis*, *Panthera*, *Pardus*, *Léopardus*, *Nemer*, *Pantherfell*; . . .
[p. 1060] b. [*sic*] *P. F. chalybeata*; . . .
f. Geäugelt
8. Art. *P. dubia*; . . .
**Panthère femelle*; . . .
[p. 1061] 9. Art. *P. americana*, *F. Onza*; . . .
**Tlatlauhqui—Ocelotl s. Tigris mexicana*; . . .

[p. 1062] **Jaguara Brasiliensibus, nobis Tigris, Lusitanis Onca;* . . .
*Jaguarete; . . .
[p. 1066] b. [*sic*] Schwarzer Jaguar; . . .
**Jaguarete Brasiliensibus, Onca itidem Lusitanis;* . . .
*Schwarzer Jaguarete; . . .
3. Tiger, Gestreift.
a. Klein, Streifen und Flecken unbestimmt.
1. Art. *Tigris minima, F. bengalensis;* . . .
2. Art. *T. europea, Catus vulgaris, F. catus*, gem. K.; . . .
[p. 1068] 3. Art. *T. F. japanica*, wilde indische K.; . . .
4. Art. *T. F. guttata;* . . .
5. Art. *F. pantherina*, Panthère Perrault; . . .
[p. 1069] 6. Art. *T. cajennen., F. tigrina, Margay, Maraguao, Tepe-Mazl.*, ob *Pichou;* . . .
b. Gewellt.
7. *T. maxima, F. tigris*, gem. Tiger
[p. 1070] 4. Löwen; ungefleckt.
a. Schwarze.
1. Art. *Leo niger, El negro*, schwarze Katze; . . .
2. Art. *L. griseus*, Jaguarundi; neu, . . .
b. Fahle
3. Art. *L. rufus*, Eyra; neu, . . .
4. Art. *L. brunneus*, Pajero, Pampas?; . . .
[p. 1071] 5. Art. *L. sibiricus, F. Manul*, Steppenkatze, wilde Tigerkatze, Steinkatze;...
6. Art. *F. concolor, Tigris fulva;* . . .
**Leo americanus, Puma;* . . .
[p. 1072] **Cuguacu—Arana Brasiliensibus, Tigre Lusitanis;* . . .
**Couguar, Cuguacu—Ara, Tigris fulvus*, in Gûana rother Tiger; . . .
[p. 1073] **Pagi* in Chili, *Puma* in Peru, *Mitzli* in Mexico; . . .
[p. 1074] *Guazûará; . . .
b. [*sic*] *Felis discolor*, schwarzer Cuguar; . . .
7. Art. *L. vulgaris, F. Leo*, gem. Löwe; . . . "

Remarks.—It is evident from the above that the name "Panthera" Oken, cannot be accepted as a technical name. The only technical name unequivocally given by Oken to the genotype of J. A. Allen's and Palmer's alleged genus *Panthera*, is "*Pardalis* oder ächter Panther" (p. 1058). *Pardalis* as employed by Oken is a monomial specific name included in the genus *Felis*. Furthermore, according to the various forced and conflicting interpretations of Oken's nomenclature by J. A. Allen and by Palmer, "Panthera" if momentarily accepted as a legitimate generic name can be applied with certainty only to *F. colocolo* (Oken, p. 1052). This species becomes automatically the genotype. *Panthera*, with *P. vulgaris* Oken, genotype, as cited by Allen, Palmer, and others, is, therefore, a dead homonym.

Valid pertinent name: Felis Linnaeus, 1758, is still current for the larger cats. *Panthera* Severtzow, 1858, is preoccupied by *Panthera* Hübner, 1823, a genus of *Lepidoptera*. *Leo* Brehm, 1829, as a generic or subgeneric name is available if the leopard and lion are regarded as strictly congeneric. *Panthera* Frisch, 1775, also listed by Palmer (pp. 828, 955) is not available and has generally been ignored by authors who date *Panthera* from Oken (*ex* Palmer) and other names from Frisch (*ex* Palmer).

Leo, Palmer (Index Gen. Mamm., p. 368; cited from Oken, pp. 1070–1076).
"*Leo vulgaris* (= *Felis leo* Linnaeus, type)."
For Oken's treatment of *Leo*, see **Panthera** above.
Valid pertinent name: Leo Brehm, 1829, as a genus, or as a subgenus of *Felis*. *Leo* dated from Frisch, 1775, is not available.

Tigris, Palmer (Index Gen. Mamm., p. 680; cited from Oken, pp. 1066–1070).
"*T. maxima* Oken (= *Felis tigris* Linnaeus, type)."
For Oken's treatment of *Tigris*, see **Panthera** above.
Valid pertinent name: Tigris Gray, 1843. *Tigris* Frisch, 1775, not available. According to Pocock (Ann. Mag. Nat. Hist., ser. 8, vol. 18, p. 306 *et seqq.*, 1916), the lion, tiger, leopard, and jaguar are congeneric and his use of the name *Panthera* Oken (*ex* Palmer) for these species may be replaced by *Leo* Brehm, 1829.

SUMMARY

None of the above names credited to Oken, 1816, has the status of a generic name in the "Lehrbuch." Oken's system of nomenclature is neither Linnaean nor scientific. Most names proposed by Oken for his categories are expressed in vernacular or pseudo-scientific terminology. Valid technical and other Latin names employed by Oken are generally traceable to Linnaean and pre-Linnaean authors, respectively. Their usual status in the "Lehrbuch" is superficially comparable to that of synonyms in Linnaean methods. Except by analogy, it is impossible to classify any of the hierarchies of Oken's system in terms of categories admitted into the Linnaean system. In no case can it be shown that names credited to Oken are clearly and unambiguously equivalent to technical generic terms as understood by the very authors who have accepted names dated from the "Lehrbuch." Indeed, most generic names credited to Oken appear in the "Lehrbuch" as either supergeneric categories or as specific, pre-Linnaean classical, or vernacular terms.

Of twenty-eight terms credited to Oken in Palmer's "Index Generum Mammalium" and other comparatively recent publications, five, namely, "*Cetus*" "*Lupus*," "*Mapurito*," "*Zibetha*" and "*Pecus*" have not been adopted by authors. Another five names, "*Oryx*," "*Myopterus*," "*Pusa*," "*Sylvanus*" and "*Satyrus*" have been rejected by authors as preoccupied. Six names, "*Mussascus*," "*Monichus*," "*Psilodactylus*," "*Faunas*," "*Cemas*" and "*Orasius*" have been regarded as antedated and are not used by authors.

Five names credited to Oken have been correctly proposed as genera by later authors and should be cited as *Vulpes* Fleming, 1822, *Zorilla* Geoffroy, 1826 (in the "Lehrbuch" "Zorille," not *Zorilla* as misquoted by authors), *Genetta* Cuvier 1817, *Leo* Brehm, 1829, and *Tigris* Gray, 1843.

Oken's name "Viscaccia," submitted to the International Commission on Zoological Nomenclature for a decision on availability, was rejected in favor of *Lagidium* Meyen, 1833.

Three names credited to Oken are used by some modern authors but rejected by those familiar with the "Lehrbuch." *Vulpicanis* Blainville, 1837, is already replacing "Thos" Oken. *Galictis* Bell, 1826, is well known and was widely used long before Oken's vernacular term "Grison" was adopted. *Eira* H. Smith, 1842, is established and derived from the same vernacular term "Tayra" used by Oken.

The only source for current usage of *Pan* as a valid generic name for the chimpanzee is neither Oken nor Palmer, but is Elliot's despairingly erratic "A Review of the Primates" (Amer. Mus. Nat. Hist., Monogr. ser., vol. 3, p. 227, 1913).

Stiles and Orleman (Hygienic Lab., Bull. 145, U. S. Pub. Health Serv., Treas. Dept., Washington, D. C., p. 59, 1927) listed *Pan* Elliot, 1913, as the last of nine available names for the chimpanzee. They stated (*op. cit.*, p. 62) that with the suppression of the hopelessly confused *Simia* Linnaeus, 1758, "*Theranthropus* [Brookes] 1828, *Chimpansee* [Voigt] 1831, and *Anthropopithecus* [Blainville] 1838 are the next three names to be considered as generic names for the chimpanzee. As *Theranthropus* 1828 is a 'sales catalogue name,' therefore subject to discussion as to its availability, we concede to mammalogists its rejection. It is not clear to us, however, how such a long name of difficult pronunciation as *Antropopithecus* 1838 is preferable to the earlier short, *Chimpansee* 1831 of easy pronunciation. Accordingly, we find ourselves at friendly issue with the mammalogists, but we retain an open mind to listen to the arguments which have induced 22 specialists to reject *Chimpansee* and to select *Anthropopithecus*. We suspect that they momentarily overlooked the existence of *Chimpansee* 1831." The writer agrees that the name *Chimpansee* Voigt, 1831, is the earliest valid, and at the same time the most appropriate, generic name for the chimpanzee.

Oken neither proposed nor used "Panthera" in any way that can be construed as a technical name applicable to the leopard and related species. Until recently, use of *Panthera* as a generic term for the leopard, lion, tiger, and jaguar, was dated from Severtzow, 1858. Unfortunately, Hübner, in 1823, published the same name for a genus of Lepidoptera. Undaunted, Pocock (Ann. Mag. Nat. Hist., ser. 8, vol. 18, pp. 314–315, 1916) permitted himself to be seduced by the still earlier date of the "Lehrbuch" and pronounced Oken first author of the name *Panthera*. Apparently, earliest available names for the felids in question are, *Leo* Brehm, 1829, for the lion, *Tigris* Gray, 1843, for the tiger, and *Jaguarius* Severtzow, 1858, for the jaguar. These cats are now regarded as congeneric and where generic or subgeneric separation from *Felis* Linnaeus is advised, the name *Leo* is applicable.

Finally, Cuvier's well known and hitherto universally employed *Spermophilus* 1825, must be revived for the ground squirrels currently referred to *Citellus*, a name improperly credited to Oken, 1816.

CONCLUSION

Stability of zoological nomenclature will never be attained as long as authors exercise indiscriminately their privilege of introducing into the literature any name that suits their fancy or convenience. Few users of scientific terminology have the means, the time, or the inclination to verify the validity of each name they use. They are prone to accept, and thus tend to promote the perpetuation of, names as they find them in secondary bibliographic references. The practice of overturning valid, well established names in favor of others derived from unacceptable or questionable sources has degenerated from a nuisance to a calamity and reflects discredit on the work of systematists. There are many more names in Oken, 1816, Frisch, 1775, and Zimmermann, 1777, to which careless authors can help themselves for a quick solution of a tormenting problem in nomenclature. There are many other non-Linnaean authors offering hosts

of names with alluringly early date marks. All names proposed by such authors must be peremptorily suppressed, without qualm or qualification. The time is come when discussions of nomenclature are no longer to be treated primarily as abstruse questions of author, date, and orthography, but shall be regarded as matters fundamentally of zoological interest.

Chicago Natural History Museum, Chicago 5, Ill. Received April 20, 1948.

THREE NEW RACES OF BADGERS (*TAXIDEA*) FROM SOUTHWESTERN UNITED STATES

By Viola S. Schantz

Further studies of the North American badgers reveal three new races from Texas, Arizona, and Nevada, respectively. I wish to acknowledge with thanks the courtesy extended to me by the American Museum of Natural History; Carnegie Museum of Pittsburgh; Chicago Academy of Sciences; Museum of Vertebrate Zoology, University of California; and Museum of Zoology, University of Michigan, for the loan of specimens indicated in the following descriptions.

Examination of specimens has shown that the badgers of the coastal area of the Gulf of Mexico, from Corpus Christi, Texas, southward, constitute a previously unrecognized race, which is described as:

Taxidea taxus littoralis, subsp. nov.

Type.—No. 116763, U. S. National Museum, Biological Surveys collection; adult male; skin only; collected at Corpus Christi, Nueces County, Texas; August (?) 6, 1901, by J. M. Priour. Original number 1; Biological Surveys miscl. no. 3611X.

Distribution.—The coastal area of Texas from Corpus Christi southward along the Gulf coast and inland to Coahuila, Mexico; Lower Austral Life Zone; Lower Sonoran Fauna; Tamaulipan Biotic Province (Dice, The Biotic Provinces of North America, p. 61, map 1, 1943).

Diagnostic characters.—Individuals of this race are more heavily washed with black than are those of *berlandieri*, and the long white median dorsal stripe extends from near the nostrils to the rump. The hairs, basally, are pinkish cinnamon (Ridgway, Color Standards and Color Nomenclature, 1912), rather darker than cinnamon-buff as in *berlandieri*.

Color.—Type: Summer pelage. Facial area, including eyes, forehead (except median line), and cheek patches, black as usual in this species; white median line extends from near the tip of the nose to the rump; white markings under and behind the eyes are confluent with light buffy underparts of throat and neck; general dorsal area exclusive of white median line is a mixture of black, pinkish cinnamon, and gray, with black predominating, the guard hairs are pinkish cinnamon basally, followed by a black band, then a narrow pinkish cinnamon subapical band, and finally a gray tip; the sides are similar to the back, but possess longer guard hairs with wider subapical bands of pinkish cinnamon and longer gray tips; anterior part of, and median spot on, chin dark brown; general abdominal area pinkish buff, becoming buff along a narrow median line; ears blackish edged with white; fore and hind legs black; upper side of tail similar to back, but basal hairs cinnamon and tip of tail black; under side of tail predominately cinnamon.

Young badgers are frequently paler than are adults. This is true of a young specimen

from Brownsville, Texas. The light hair tips are longer, thus having a much lighter effect, than in an adult specimen from the same place, which is heavily washed with black.

Skull.—In general, similar to *T. t. berlandieri*, but noticeably smaller than specimens of that race from Laredo and Sabinal, Texas, where *berlandieri* apparently attains its largest size. The condylobasal length of a male specimen of *berlandieri* from Laredo measured 125.8 mm., and another from Sabinal, 132; and three females from Sabinal measured 119.2, 121.4, 128.0.

Measurements.—Skin (adult female) taken at La Ventura, Coahuila: Total length, 668 mm.; tail, 113; hind foot, 101.

Average and extreme skull measurements of three males: Condylobasal length, 120.8 mm. (120.0–121.3); zygomatic breadth, 80.5 (73.6–84.5); mastoidal breadth (of two), 73.2 (70.0–76.4); interorbital breadth, 28.7 (27.5–30.5); least postorbital breadth, 28.7 (25.5–30.5); palatal constriction, 15.2 (14.8–15.5); palatalar length, 61.5 (61.0–64.3); maxillary tooth row, 41.1 (40.5–43.2); crown length of pm^4, 11.8 (11.4–12.2); crown width of pm^4, 10 (9.8–10.3); crown length of m^1, 13.5 (13.0–13.8); crown width of m^1, 11.1 (10.7–11.3). Measurements of two female skulls: Condylobasal length, 117, 117; zygomatic breadth, 73.0, 74.6; mastoidal breadth, 73.0, 74.7; interorbital breadth, 25.7, 26.2; least postorbital breadth, 27.0, 27.0; palatal constriction, 14.0, 14.5; palatalar length, 56.8, 59.0; maxillary tooth row, 39.5, 40.0; crown length of pm^4, 11.0, 11.0; crown width of pm^4, 9.2, 9.3; crown length of m^1, 12.7, 13.0; crown width of m^1, 10.0, 10.1.

Remarks.—*Taxidea taxus littoralis* is most closely allied with *T. t. berlandieri*. Northwest of Corpus Christi, Texas, it intergrades with that race, as evidenced by specimens from Sabinal, Texas, which are slightly washed with black.

Specimens examined.—Total number, 7, as follows: TEXAS: Brownsville, Cameron County, 2 (skins and skulls, 1 Univ. Michigan coll.); Corpus Christi, Nueces County, 1 (skin only, type); Padre Island, 1 (skull only). COAHUILA: La Ventura, 1 (skin and skull). TAMAULIPAS: Matamoras, 2 (skulls only).

While continuing studies of North American badgers more intensely, I have concluded that the small specimen from southwestern Arizona, previously recorded (Schantz and Halloran, Jour. Mamm., p. 75, Feb., 1948) as an extension of range of *Taxidea taxus sonoriensis*, actually represents a new race distinct from *sonoriensis*, *berlandieri*, and *apache*, the latter two being bordering races. I name it for the collector of the type specimen, Arthur F. Halloran:

Taxidea taxus hallorani, subsp. nov.

Type.—Castle Dome Mountains, Kofa Game Range, Yuma County, Arizona. No. 275196, ♂ adult (coronal sutures fused), skin and skull; U. S. National Museum, Biological Surveys collection; collected by Arthur F. Halloran, February 18, 1947. Original number 32552X (135). The Kofa Game Range is principally a desert bighorn sheep refuge.

Distribution.—This badger, *T. t. hallorani*, occurs mostly in the Southern Gray Desert Soils (C. F. Marbut, Atlas American Agriculture, 1936, pl. 2), extending from southeastern Nevada, latitude 36° 30′, southward into a small section of southeastern California, longitude 114° 45′ to 115° 30′ and latitude 34° 50′ to 35° 20′; in Arizona west of 111° longitude, excepting Beaver Creek and Santa Catalina Mountains, and south of 35° 40′ latitude; extreme northeastern Baja California and northwestern Sonora. The average annual precipitation for this area is from 5 to 10 inches (J. B. Kincer (1922), Atlas American Agriculture, p. 7, 1936). Lower Sonoran Zone; principally in the Mohavian and Sonoran Biotic Provinces (Dice, 1943).

General characters.—This is a small, light pinkish buff subspecies lightly washed with black; guard hairs tipped with gray in winter and light tan in summer, giving it a buffy, black, grayish mixture in winter, and a buffy, black, tannish mixture in summer, always with the pinkish buff color predominating.

In this subspecies the median white dorsal stripe varies in length. In about 17 per cent of the specimens this stripe ends posteriorly near the shoulder; in 48 per cent it is interrupted

or faint and extends beyond the shoulder; while in 35 per cent it is continuous and extends beyond the shoulder, as far as the tail in several of the specimens. Occasionally, specimens from one locality may show the extremes of variation in the subspecies. The stripe varies in length and distinctness in specimens from one locality. On the type specimen, the stripe narrows on the back of the head and barely reaches the shoulders; others from the type locality have suggestions of the stripe beyond the shoulder.

Color.—Type: Black facial markings of eyes, forehead (except median white line), and preauricular patches as usual in this genus; irregular white markings under and behind the eyes confluent with white throat; white median line extends from near tip of nose over the forehead to the shoulder; dorsal area and sides predominantly pinkish buff (Ridgway, 1912), the hairs drab at base (Ridgway; and Maerz and Paul, Dictionary of Color, 1930), then banded with pinkish buff (Ridgway) or beige, in the guard hair this band is a honey beige (Maerz and Paul, 1930); then a subapical band of black and a terminal band of white; fur of abdominal area light buff, lightly tipped with cinnamon; chin and spot at base of median tuft of gular vibrissae brownish; ears dark brown edged with white; fore and hind legs black; upper side of tail cinnamon-buff with a subapical band of dark brown tipped with gray, underside of tail predominantly cinnamon-buff.

Skull.—Smaller in average size than those of its closely allied races, *apache* and *berlandieri*.

Measurements.—Type: Total length, 629 mm.; tail vertebrae, 114; hind foot, 89. Skull: Condylobasal length, 113.8; zygomatic breadth, 73.6; mastoidal breadth, 68.6; interorbital breadth, 27.5; least postorbital breadth, 29.1; palatal constriction, 13.5; palatalar length, 56.0; maxillary tooth row, 39.3; crown length of pm^4, 11.0; crown width of pm^4, 9.7; crown length of m^1, 12.0; crown width of m^1, 10.0.

Skin measurements of an adult male topotype: Total length, 651 mm.; tail vertebrae, 107; hind foot, 89. Adult female topotype: 676, 123, 98.

Average and extreme skin measurements of nine adult males, 641 (629–685); 114 (108–126); 93 (89–100). Average and extreme skin measurements of nine females, 638 (591–676); 122 (115–123); 96.4 (95–98).

Average and extreme cranial measurements, in millimeters, of fourteen males: Condylobasal length, 116.1 (109.1–125.3); zygomatic breadth (of 11), 72.6 (68.9–76.2); mastoidal breadth (of 10), 71 (66.5–76.6); interorbital breadth (of 11), 26 (24.4–27.5); least postorbital breadth (of 9), 27.5 (25.7–29.1) palatal constriction, 14.2 (13.0–15.1); palatalar length, 58.1 (53.3–63.7); maxillary tooth row (of 13), 39.6 (36.7–42.0); crown length of pm^4, 11.1 (10.0–12.5); crown width of pm^4, 9.7 (8.7–11.1); crown length of m^1, 12.9 (12.0–14.3); crown width of m^1, 10.4 (9.7–11.8).

Average and extreme cranial measurements of 17 females: Condylobasal length, 114.9 (109.2–119.5); zygomatic breadth (of 16), 69.9 (64.6–73.6); mastoidal breadth, 68.6 (66.1–71.0); interorbital breadth (of 15), 25.9 (24.4–28.5); least postorbital breadth (of 13), 27.2 (25.3–29.0); palatal constriction (of 16), 13.7 (12.5–14.4); palatalar length, 56.8 (53.9–60.0); maxillary tooth row, 39.1 (36.2–40.5); crown length of pm^4, 10.8 (9.8–11.6); crown width of pm^4, 9.5 (8.8–10.6); crown length of m^1, 12.6 (11.6–13.5); crown width of m^1, 10.1 (9.4–11.0).

Weights.—Weights of three adult males: 8 pounds (type); 9½ pounds (topotype); 14 pounds (Sierra Pinta, Yuma County, Ariz.). One adult female containing two embryos, 8½ pounds (topotype).

Remarks.—*Taxidea taxus hallorani* is a small race of badger which intergrades with *berlandieri* from the east and *apache* to the southeast.

Specimens.—Total number, 39, as follows: ARIZONA: Beaver Creek, Greenlee County, 1 (skull only, Amer. Mus. Nat. Hist.); Colorado River, Old Searchlight Ferry, Mohave County, 2 (skins and skulls); Congress Junction, Yavapai County, 3 (skins and skulls, 2 Chicago Acad. Sci.); Fort Verde, Yavapai County, 2 (1 skin only, 1 skull only, Amer. Mus. Nat. Hist.); Gillespie Dam, Maricopa County, 1 (skeleton); Kofa Game Range, Castle Dome Mountains, type locality, 3 (skins and skulls); Peppersauce Canyon, Santa Catalina Mountains, Pima County, 1 (skin and skull, Carnegie Mus.); Pinal County, 1 (skin and

skull, Amer. Mus. Nat. Hist.); San Francisco Mountains, north base, Coconino County, 2 (skulls only, Carnegie Mus.); Sierra Pinta, Yuma County, 1 (skin and skull); Tinajas Atlas Mountains, Yuma County, 1 (skin and skull); Tule Well, Yuma County, 1 (skin and skull); Yuma, Yuma County, 2 (skins and skulls). BAJA CALIFORNIA: Laguna Salada, 10 miles south of International Boundary, 1 (skin and skull). CALIFORNIA: Cima, San Bernardino County, 3 (2 skulls only, 1 skin and skull, Mus. Vert. Zool.); Kelso, San Bernardino County, 1 (skin and skull, Mus. Vert. Zool.); Needles, San Bernardino County, 2 (skins and skulls). NEVADA: Ash Meadows, Nye County, 1 (skin and skull); California–Nevada Monument, 2½ miles north, Clark County, 2 (skins and skulls, Mus. Vert. Zool.); Durban Ranch, 14 miles east of Searchlight, Clark County, 1 (skull only, Mus. Vert. Zool.); Jap Ranch, east of Searchlight, Clark County, 1 (skin and skull, Mus. Vert. Zool.); Thomas Ranch, 14 miles east of Searchlight, Clark County, 4 (skulls only, Mus. Vert. Zool.); Vegas Valley, 1 (skin and skull). SONORA: Quitovac, 8½ miles north, 1 (skull only, Mus. Vert. Zool.).

A new race of badger peculiar to the Desert Game Range, a big game refuge in southern Nevada and the area westward to the Death Valley and Panamint Mountains in California, is here recognized as follows:

Taxidea taxus nevadensis, subsp. nov.

Type.—White Sage Flat, between Desert Range and Sheep Range, Desert Game Range Nevada. No. 276077, adult male (coronal sutures fused); skin and skull; U. S. National Museum, Biological Surveys collection; collected by O. V. Deming; June 27, 1947. Original number 33134X(1).

Distribution.—The Desert Game Range, an area covering 2,022,000 acres in southern Nevada, and that part of southern Nevada and southeastern California north of the range of *Taxidea taxus hallorani*, at 36° 45′ N. latitude, and west to Death Valley and the Panamint Mountains, California; Lower Sonoran Region; Northern part of Mohavian Biotic Province (Dice, 1943). The average annual precipitation for this area is from 5 to 10 inches (J. B. Kincer (1922), Atlas Amer. Agric., p. 7, 1936).

General characters.—A small cinnamon-buff badger, heavily washed with black, and with a white dorsal median line of varying lengths. On the type specimen, taken on the Desert Game Range, Nevada, this stripe ends at the shoulder; on a second specimen from this Game Range it ends on the back of the head; and on a third specimen from this range it extends to the tail. This race is darker than, and the males average similar in size to, *hallorani*, but the females average slightly smaller than *hallorani* bordering it to the south.

Color.—Type: Summer pelage. Black facial markings of eyes, forehead (except median white line), and preauricular patches as usual in the species; irregular white markings under and behind the eyes confluent with creamy throat; white median line extends from near tip of nose over forehead to the shoulders; general dorsal area and sides predominantly black, the hairs consisting of a cinnamon-buff (Ridgway) or walnut taffy (Maerz and Paul) basal band then a wide black subapical band, and a gray tip; abdominal area light cinnamon-buff, excepting an irregular light buff median line; chin slightly brownish; small median chin spot at base of gular vibrissae dark brown; ears black, edged with white; forelimbs and hind limbs black; upper side of tail predominantly cinnamon, the subapical black band is narrower, and the gray tip shorter than on the dorsal area; under side of tail similar, but hairs lack the subapical black band; tail terminates in a black tuft.

Skull.—Males of *nevadensis* average similar to those of *hallorani* and smaller than those of *taxus* and *neglecta*.

Measurements.—Type: Total length, 648 mm.; tail vertebrae, 120; hind foot, 95. Skull: Condylobasal length, 121.5; zygomatic breadth, 76.0; mastoidal breadth, 75.5; interorbital breadth, 28.4; least postorbital breadth, 29.0; palatal constriction, 14.3; palatalar length, 60.4; maxillary tooth row, 41.2; crown length, pm^4, 11.4; crown width, pm^4, 10.0; crown length, m^1, 13.2; crown width, m^1, 10.5.

Adult female and male, respectively, from Desert Game Range, Nevada: Total length, 521, 686; tail vertebrae, 98, 117; hind foot, 89, 101.

Average and extreme skull measurements of 3 females: Condylobasal length, 110.5 mm. (108.5–113); zygomatic breadth (of 2), 67.7 (66.4–69.0); mastoidal breadth, 66.7 (64.6–68.8); interorbital breadth (of 2), 24.7 (24.3–25.0); least postorbital breadth (of 2), 27.5 (26.5–28.5); palatal constriction, 13.9 (13.5–14.1); palatalar length, 54.7 (52–57.1); maxillary tooth row, 37.7 (36.5–38.4); crown length, pm^4, 10.1 (8.9–11.4); crown width, pm^4, 8.8 (8.5–9); crown length, m^1, 11.8 (11.4–12); crown width, m^1, 9.4 (9.2–9.8).

Average and extreme skull measurements of 4 males: Condylobasal length, 117.8 (115.7–121.5); zygomatic breadth, 73.8 (71.0–76.0); mastoidal breadth, 71.6 (67.1–75.5); interorbital breadth, 27.0 (24.5–28.4); least postorbital breadth, 28.1 (26.0–29.2); palatal constriction, 14.5 (14.0–15.0); palatalar length, 58.6 (57.1–60.4); maxillary tooth row, 40.2 (38.5–41.2); crown length, pm^4, 11.0 (9.7–11.8); crown width, pm^4, 10.1 (10.0–10.2); crown length, m^1, 12.6 (11.5–13.2); crown width, m^1, 10.1 (9.5–10.5).

Remarks.—Taxidea taxus nevadensis is distinct in its small size and dark coloration. Its size is near that of *hallorani*, and its coloration, exclusive of dorsal stripe, resembles that of *neglecta*. The white median dorsal stripe varies in length, as in *hallorani*. In six specimens, two, a male and female, have irregular stripes from near the tip of the nose to the tail; three, two males and a female, have stripes from near the tip of the nose to the shoulders; and one has a stripe from near the tip of the nose to the back of the head. The presence of this long stripe in some of the specimens is evidence of intergradation with *berlandieri*.

Specimens.—Total number, 8, as follows: CALIFORNIA: Death Valley, Inyo County, 3 (1 skin and 3 skulls, 1 skin and skull, Mus. Vert. Zool. coll.); Panamint Mountains (W. side), Inyo County, 2 (skins and skulls). NEVADA: Desert Game Range: Las Vegas, 20 miles northwest, Desert Game Range Headquarters, Clark County, 1 (skin and skull); White Sage Flat, between Sheep Mountain and Desert Range (type locality), 1 (skin and skull); and Willow Creek in Spring Mountain Range, Clark County, 1 (skin and skull).

U. S. Fish and Wildlife Service, Washington 25, D. C. Received January 21, 1949.

GENERAL NOTES

THE SCREAM OF THE MOUNTAIN LION

In the Young and Goldman book on *The Puma*, (American Wildlife Institute, 1946) mention is made (p. 84) of the long-standing controversy as to whether the mountain lion (*Felis concolor*) screams or not. The present account supports the contention that the cat definitely screams or that it may even be said to roar.

The observations took place in the Sierra Madre at an elevation of 5800 feet, seven miles southwest of Colonia Pacheco, Chihuahua, Mexico. I was camped with A. H. Miller, A. S. Leopold, and W. C. Russell, all of the Museum of Vertebrate Zoology, Berkeley, California.

On August 2, 1948, a bright clear day, Leopold and I were hunting wild turkeys on the north side of White Rock Canyon which enters the Gavilan River from the northeast. I was on the side toward the sheer walls of the canyon proper. When I was about half way up to the mesa above the canyon at 8:30 A.M., I heard a very loud roar which sounded much like the roar of an African lion in a zoo, although of a higher pitch and shorter duration. This roaring continued for several minutes. Looking back on it now, I feel at a loss further to describe the sound although the impression is none the less vivid. The caterwauling seemed to come from above the canyon in the upper end of a side draw. In about ten minutes the performance was repeated, this time farther down the draw toward the canyon proper. In the next half hour, the cat proceeded 600–700 yards down the draw into the floor of White Rock Canyon and down the canyon toward the Gavilan River, the main drainage channel of the watershed. During this journey the animal caterwauled five times. I did not change my hunting course, but paused to listen and to see what the lion would do once it reached the river. When it turned and doubled back, I raced for the edge of the canyon.

Up to this point twenty minutes had elapsed from the time I had first heard the animal, and I could tell what it was doing only by its roaring. I no sooner got to the edge of the canyon and lay prone on a vantage point when I saw the lion on the opposite side of the canyon about 250 yards away. It was a large cat, and after walking about twenty-five yards it began to caterwaul. The only particulars of the roaring that I could recall later were that the head was moved from side to side and that the walking pace was slowed down during the performance. For the next twenty minutes I had the lion in full view as it proceeded up the south side of the canyon opposite me. Once it made a slight detour, but reappeared almost directly across the canyon about seventy-five yards away. The trail used by this puma was a series of ledges on the sheer rock escarpment. When the animal got directly opposite me, I shot at it with a 16-gauge rifled slug, but missed. The lion stopped abruptly, looked up and down the canyon for a minute or more, then slowly, and apparently undisturbed, continued on his way and was soon lost in the rocks and brush.

Alden H. Miller, who was hunting about a quarter mile south of the draw from whence the lion first caterwauled, heard the entire performance as did Leopold, who had come over to the canyon rim from the north, but neither saw the cat.

Several days earlier Leopold wounded an adult lion that was traveling with two yearlings, about one half mile from the site of these observations. It seems possible that Leopold's animal was a female and the lion I watched was an adult male.

On one other occasion I heard a lion roar. This was earlier on July 23. I was riding back to camp at dusk on a trail when a lion screamed overhead on the opposite side of a rather steep-sided canyon. At the time I did not know what it was, although it gave me quite a start. The horse was not affected by this single scream.

The literature on the voice of the mountain lion is well reviewed in Young and Goldman (*op. cit.*). Bailey's description (The Mammals and Life Zones of Oregon, N. Amer. Fauna, No. 55, 1936) is virtually identical with the observations made in northern Chihuahua.—ROBERT A. MCCABE, *424 University Farm Place, Madison, Wisconsin.* *Received December 9, 1948.*

STRANGE BEHAVIOR OF A LEAST WEASEL, *MUSTELA RIXOSA ALLEGHENIENSIS*

While walking through a field east of Findlay, Ohio, near the Millpond, on November 8, 1947, one of my students, Rex Smith, heard a "squeaking" in the grass. Walking toward the sound he found a male least weasel, *Mustela rixosa allegheniensis*, sitting erect and "squeaking" at a distance of twenty-five feet from a fencerow. It made no attempt to escape. He picked it up, pocketed it, and carried it home, where it was kept in a small shoe box until the following Monday. During the interim it was fed nothing but weakened cow's milk from an eyedropper. I kept it in a cage in the laboratory for eight days before it died. During this time I fed it raw hamburger, presented on the end of my finger. The weasel spent most of each day hidden in a household matchbox, in the end of which I had cut an opening one inch square. Its eyesight seemed to be very poor. It would come out to accept the meat proferred it and would immediately return to the matchbox with the food. The matchbox was about one and one-half inches from the side of the cage and often as not when the animal attempted to enter the box it ran through this opening instead of the one in its hiding place. The weasel was in summer pelage. Its measurements were as follows: total length, 152 mm.; tail, 31 mm.; hind foot, 18 mm.; weight, 24.56 grams.—RICHARD STUART PHILLIPS, *Biol. Dept., Findlay College, Findlay, Ohio.* *Received November 30, 1948.*

PARTURITION OF THE NUBIAN GIRAFFE (*GIRAFFA CAMELOPARDALIS*)

Of the many births that have occurred in The National Zoological Park, I have not been able to find a description of the phenomenon of parturition. The daily reports of the animal department record only the event of a birth. It is true that many animals are born without the benefit of an observer. However, most of the larger mammals are under observation,

by their keepers, during their period of gestation, for the approximate date of parturition is known.

I had the good fortune to be present and observe in minute detail the parturition of a Nubian giraffe. The mother, obtained in 1937 by the National Geographic Society-Smithsonian Institution Expedition, is about twelve years of age. She had produced two calves by previous matings. The female was mated in August, 1947, but it was impossible to determine the exact date of conception, as many attempts at copulation were made by the pair. Approximately fourteen months later, October 2, 1948, the first stages of parturition were observed at 9:00 A.M. The previous night the dam displayed anxiety by pacing her cage and eating very little of her evening meal that consisted of concentrate and alfalfa hay. As labor progressed the animal walked continuously and did not attempt to lie down. There was much mucus on the vulva as the pasterns of the forelegs appeared. The hoof tips were first to appear and upon each straining movement an additional inch or more of the appendages protruded. At 10:00 A.M. the foetus was exposed to the extent of the forelegs up to the radius and ulna. At this point the tongue of the foetus came into view, it appeared as if the head of the infant was in a lateral position lying to the mother's left side. In a normal presentation, the head is extended in position between the forelegs thereby forming a natural wedge effect. At each uterine contraction more of the foetus appeared until its head and a portion of the humeri came into view. Life was evident from the movement of the tongue and lips of the calf. At this stage labor appeared difficult, for the muscles of the vagina contracted on the cervical portion of the foetus. A keeper and I entered the cage and grasped the forelegs of the young. As the mother strained we assisted her with a downward pulling motion. This assistance enabled the mother to expel the calf to a point just posterior to the shoulders. At 10:40 A.M. the entire foetus was expelled, dropping to the floor from a height of about five and one-half feet. The fluids from the embryonic sacks were profuse and bathed the young animal as the process of birth terminated.

The mother turned around and investigated her offspring, carefully stepping around the infant as she licked the natal membranes from the nose and eyes. The umbilical cord was wrapped around the body and appeared to be about three feet in length. At 11:45 A.M., after several attempts to arise, the calf was on its feet, although its state of equilibrium was at times doubtful. At 12:35 P.M. the youngster had located the mammary glands of its mother and was consuming the colostrum from the left posterior teat. At 2:00 P.M. the entire placenta was expelled.

The foregoing description is comparable to the parturition of a typical ungulate, and is offered as the lone description of the birth of *Giraffa camelopardalis*.—MALCOLM DAVIS, *The National Zoological Park, Washington, D. C. Received January 25, 1949.*

HIBERNATING MEADOW JUMPING MOUSE

Since the time of emergence from hibernation of the meadow jumping mouse (*Zapus hudsonius*) is not well established and accounts of the hibernating mouse and nest are mostly fortuitous and few in number (Hamilton, Amer. Midland Nat., 16: 192, 1935; Nicholson, Jour. Mamm., 18: 103, 1937; Sheldon, *ibid.*, 19: 332, 1938; and Dilger, *ibid.*, 29: 299, 1948) the following observations are placed on record.

On April 29, 1944, at Ithaca, New York, while digging in a heap of soil beside a small stream and near a road, my young son unearthed a nest containing a hibernating *Zapus*. The nest was about the size of a baseball and was situated ten inches below the surface on the southern slope of the mound about one foot above the general ground surface. The mound of earth was approximately 6 x 4 feet at the base and 3 feet high. The nest was compactly made of fine grasses and no visible tunnel could be found leading to it.

When removed from the nest the hibernating mouse was curled into the position seemingly characteristic of both hibernating *Zapus* and *Napaeozapus;* nose turned in to the belly, forefeet curled on chest, hind feet alongside of the head, and tail coiled around the body. The outside air temperature of this sunny day was 65° F. When taken indoors at 70° F. no visible sign of life was evident for fifteen minutes after which time the mouse was

seen to breathe once. Two minutes elapsed before the next visible breath after which it began to breathe at increased tempo, once every half minute at first and then more rapidly until at the end of a half hour it was breathing very rapidly. During this time the mouse began to move spasmodically. The tail was first uncurled and then each hind leg was thrust out in turn, followed by the straightening of the body with a convulsive jerk. Meanwhile the forelegs quivered continuously while the animal lay on its side.

At the end of this first half hour the mouse rolled over and sat hunched and motionless for another half hour after which its eyes were first seen to open briefly. The mouse then moved about slowly and in an uncertain fashion for approximately another hour. Some cracked corn and seeds were now presented and shortly afterward the mouse was seen eating a small quantity. Lettuce was added, but the mouse was not observed to eat any. Overnight it ate more corn and seeds and chewed up a small piece of fresh carrot. At no time during the first 48 hours was it observed to be very active although it may have been so during the night. The mouse slept on its haunches most of the time during the day with its nose tucked in toward the belly. After two days it was prepared as a museum skin and observed to be quite fat after its long hibernation.—W. Robert Eadie, *Department of Conservation, Cornell University. Received January 27, 1949.*

RED FOX TRANSPORTS PLAY OR TRAINING ITEMS TO NEW DEN

On May 9, 1946, at Ithaca, New York, a red fox den (*Vulpes fulva*) was located in an open field 150 feet from the edge of a woodlot. At various times in the next few days four or five pups were observed playing or sunning at the den mouth. Close inspection of the den site revealed the remains of several food items with which the pups had been playing. These remains were examined closely and recorded as follows: one white Leghorn, one brown chicken, one large woodchuck, and one common rat. They consisted chiefly of skin, bones, and fur or feathers, all old and partly dried.

On May 22, after having seen no signs of the fox pups for several days, a woodchuck was observed using the burrow. Concluding that the den had been deserted by the foxes a search was made for the new den which was found a quarter of a mile away in another field. The pups were observed at the new den and later inspection of this den site showed food remains that had a familiar look. They consisted of the remains of a white Leghorn, a brown chicken, a large woodchuck, and, in addition, a crow. These items, with the exception of the crow, appeared to be the same items previously observed at the other den although the rat remains had disappeared. A visit to the former den site and a careful search showed that the food remains had indeed vanished. These particular food remains were identified with certainty since they had been closely examined for several days at the original den site to determine whether they were being eaten or not.

Apparently a parent fox, or the pups, had transported these items the distance of a quarter of a mile to the new den and it is interesting to note the seeming importance of these items as playthings or training objects for the fox pups.—W. Robert Eadie, *Department of Conservation, Cornell University. Received January 27, 1949.*

PREDATION ON *SOREX* BY *BLARINA*

Apparent predation on the long-tailed shrews (*Sorex*) by the larger short-tailed shrew (*Blarina brevicauda*) has been recorded only rarely (Hamilton, Zoologica, 25: 488, 1940, and Eadie, Jour. Mamm., 29: 36, 1948). Further evidence of such predation was furnished by an unusual double capture while trapping a quadrat in an uncut timothy hay field at Ithaca, New York. Snap-back mouse traps were being used and one of them on October 3, 1947, contained a female specimen of *Sorex cinereus* and a male *Blarina*. The masked shrew was caught by the loins while the short-tailed shrew was held by the skull, which was crushed. Examination showed that the masked shrew was wounded about the head in several places from some other cause than the trap. The conclusion was drawn that it was either being closely pursued by the *Blarina* specimen after being wounded severely about the head or

that it was carried into the trap by it. The trap had been set in a runway at right angles to it.

The masked shrew weighed 2.8 grams while its enemy weighed 22.5 grams. The quarter-acre quadrat where the double capture occurred yielded ten *Blarina*, but only seven *Microtus* and the one *Sorex* in two nights of trapping. This represents a high population of *Blarina* and a relatively low one of meadow voles for such habitats locally.—W. Robert Eadie, *Department of Conservation, Cornell University. Received January 27, 1949.*

SHREW PREYING ON RIBBON SNAKE

On October 10, 1948, I encountered a Ribbon Snake (*Thamnophis*), about twenty-two inches long, engaged in a relatively violent struggle with a shrew, identified quite certainly as a short-tailed shrew (*Blarina brevicauda*). The encounter was taking place in the short grass and fallen leaves at the edge of a clearing in the characteristic upland hardwood forest near Davisburg, Oakland County, Michigan.

My attention had been attracted by the unusual writhing of the snake, and I had cautiously crawled within five feet of it before discovering the source of its troubles. A shrew emerged from the grass and leaves and began moving over the coils of the snake, biting it rapidly in many places. Instead of concentrating on any one point, the shrew seemed determined to bite every part of the snake. It had succeeded in biting off the last two inches of the snake's tail, and in inflicting a noticeable wound on the head. All of the snake's efforts were directed toward escape, and I did not see it try to bite or otherwise fight off its adversary. The shrew was extremely aggressive and seemed to be trying to pull the snake under the leaves, possibly into a hole. By this time the snake was becoming dazed and uncertain in its movements, but managed to reach the legs of a garden dirt screen at the scene of the fight, and was able to draw itself up on a cross member about nine inches off the ground. The shrew had kept hold of the snake's tail and, retiring under the leaves, kept tugging on it for some time. For some reason the shrew suddenly abandoned the fight and moved off under the leaves. It returned twice within the next ten minutes, passing under the snake, and raising its nose up through the leaves. Although the snake's tail was hanging within easy reach, the shrew apparently did not see it and moved on.

I had hoped to see this struggle concluded so did not attempt to collect either animal, but returned to the scene every few minutes for the next hour, until the snake eventually disappeared. I felt certain that the shrew could easily have killed the snake had it not been disturbed. Two weeks later I found the chewed-up remains of possibly the same ribbon snake at a spot twenty feet from the location of the fight. This find of course raised the interesting conjecture that the battle had been resumed and concluded after I lost track of the participants.—R. A. O'Reilly, Jr., *Davisburg, Michigan. Received December 31, 1948.*

NOTES ON AN ABUNDANCE OF SHREWS (*SOREX CINEREUS CINEREUS*) AND OTHER SMALL MAMMALS IN THE UNGAVA BAY REGION OF FAR NORTHERN QUEBEC

During 1947 and 1948, the writer made three trips to the Ungava Bay region under the sponsorship of the Canadian Fisheries Research Board. In the summer of 1947, and again in 1948, I was a member of a marine biological survey unit under the directorship of Dr. Max Dunbar of McGill University. From March 21 to April 17, 1948, I conducted a freshwater lake survey by setting nets under the ice. The press of other duties made the observation of land mammals necessarily limited.

Fort Chimo was selected as the base of operation for all three trips because of its proximity to an established airfield. Fort Chimo is on the east bank of the Koksoak River, approximately twenty-five miles from its mouth, and ten miles from the northern limit of trees. As a part of the widespread Canadian Shield, the region shows clearly the effects of glaciation. Fully half or more of the region consists of nearly bare rocks on hills and ridges, which are colonized chiefly by lichens and, in the depressions, moss and small herbs. In some local areas there are large numbers of glacial erratics. The entire district

is low-lying, with few or no hills rising much more than 150 feet. Fort Chimo itself is on a level terrace of glacial till along the Koksoak River. Numerous lakes and ponds pockmark the district surrounding Fort Chimo. Valleys are poorly drained and swampy, but the deep muskeg swamps of further south do not exist here.

Trees are all small and in the more exposed places show the effect of wind. Larch and black spruce are the dominant trees in the area; indeed they are the only ones except for a few poplars in favored sites. Abundant undergrowth is formed in places by willow, dwarf birch, and alders.

In 1947, I made very limited observations on mammal populations. Six mouse traps set for two nights in June on the Fort Chimo terrace yielded only one vole, *Microtus pennsylvanicus labradorius*. Fresh signs of voles, while not abundant generally in the region, were quite in evidence around the buildings of the Hudson's Bay Post. Fresh signs of small mammals were not common in the Kasigiaksiovik region on the south shore of Leaf Bay, although old signs were extremely numerous. On two occasions skeletons of lemmings, *Dicrostonyx hudsonius*, with much dried flesh still adhering were picked up at the edge of burrows.

Native and white people in the area reported that the previous year (1946) was the low ebb in the small mammal population cycle, but that now, in 1947, small mammals were starting to increase in numbers. However, the fox population continued to decline, and the winter of 1947–48 was one of the poorest fox years ever known in the area.

My first sight of a shrew in the area was on March 29, 1948, when I was camped with two Eskimo helpers at the south end of Lake Mendry. This camp was in a stand of spruce, *Picea mariana*. Snow cover was approximately twenty inches deep. A shrew was observed at noon to come out and feed on some refuse near the tent, but he disappeared under the tent before he could be captured. However, a half hour later a shrew was again observed feeding on the refuse; a successful capture was made by hand. Several traps were set that night, using the standard peanut butter–oatmeal bait, at the base of spruce trees and also under a fallen log. One shrew was caught in the trap set under the log.

Tracks in the snow were identified by the natives as shrew in various other localities in the Fort Chimo district during my stay in March and April of 1948. These tracks appeared only briefly on the surface of the snow, usually only a distance of a few yards. My observations included no shrew tracks over the extended water courses, although vole or lemming tracks were not uncommon.

Bill Saunders, a native of the region, told me that shrews had proven so troublesome at his previous camp site, about five miles south of Fort Chimo, that he had been forced to move his tent during March, 1948. Shrews liked especially the warmth of the bedroll and were very annoying during the night. He tried catching them by placing a pan of water under the camp stove and every morning several would be found drowned.

One other shrew was given to me by an Eskimo, who had caught it in his tent in April, 1948. Shrews probably come into the tents as much for food as warmth, as meat is usually readily accessible in one corner of the tent. Shrews also do damage to flour in the district.

No further observations were made on shrews in the Fort Chimo area during the summer of 1948, but especially impressive was the increase in vole population over the previous year and from spring to fall in 1948. In 1947, glimpses of live voles were rare, but in 1948 voles were extremely common and were observed nearly every day. Eskimo and Indian children would make a sport of hunting voles. It was not unusual to see one group of three to four boys obtain twenty to thirty voles, *Microtus pennsylvanicus labradorius*, in a few hours work during September, 1948. Voles were doing extensive damage in the flour warehouse by eating into flour sacks. Trapping was not very effective as abundant replacements were continually moving into the shed.

Trapping was carried out in the vicinity of the George River Hudson's Bay Post from August 22 to 30, 1948. George River drains into the southeast part of Ungava Bay, and the post is located in approximately the same degree of latitude and relationship to the tree line as Fort Chimo. However, the topography is different due to a much greater relief. There

are several hills, in close proximity to the post, which rise to 800 feet or more. Vegetation is more luxuriant in the valleys, probably because of the greater protection afforded by the hills. Twenty-eight shrews were trapped during this period by using the standard peanut butter—oatmeal bait. Shrews were taken in the willows near the edge of the river and at the top of an 850-foot hill where the voles, *Microtus*, of the lowland, had been replaced by lemmings, *Dicrostonyx*. Shrews were taken in all types of associations—among the tumbled glacial erratics, near the base of bushy spruce growth, in baited traps on bare ground, and in the moss on the slopes and summit of the hill previously mentioned. Shrews were more commonly caught at night, although on several occasions an immediate re-run of the trap-line in the morning would yield additional specimens. Shrews were at times seen to scurry across the paths around the post. Skins of eight of these specimens are now in the National Museum of Canada at Ottawa.

Little is known concerning fluctuations in populations of shrews. Further work is necessary to determine the fluctuation cycle of the shrew in the Fort Chimo area. Evidence gathered by the writer would indicate that there is very little difference between the "cycles" of the small mammals in the region, although shrews may have recovered quicker from their low numbers than the lemmings and voles, or perhaps their numbers do not fluctuate as greatly.

Shrews may have an importance as fish food in the Ungava district during periods of abundance. Bob May, Hudson's Bay Factor at George River, and an authority on the wildlife in the area, reported that he had taken a number of trout, *Salvelinus fontinalis*, and lake trout, *Cristivomer*, with shrews in their stomachs.

I wish to thank especially the following: Dr. Max Dunbar of McGill University for help and advice, Dr. R. M. Anderson of Ottawa for the verification of some of the identifications, Bob May, Hudson's Bay Factor, for his hospitality and interest in the work during my visits to Ungava Bay, and Philip Orkin, my colleague on the 1948 trip, who aided in gathering some of the data.—Henry Hildebrand, *School of Fisheries, University of Washington, Seattle 5, Washington.* *Received January 17, 1949.*

HIGHWAY MORTALITY IN NORTHERN MICHIGAN

From August 1 to 11, 1948, at the peak of the tourist season, I covered 650 miles of roads in the Upper Peninsula of Michigan, from central Marquette County to Drummond Island. A tally of mammals dead along the highway disclosed the following numbers of recognizable species: one long-tailed weasel, two striped skunks, two domestic dogs, one domestic cat, two woodchucks, one least chipmunk, five eastern chipmunks, nine red squirrels, one meadow vole, four muskrats, one house rat, one meadow jumping mouse, five porcupines, and twenty-seven snowshoe hares. In addition to these sixty-two individual mammals, one American toad, one painted turtle, one garter snake, one ruffed grouse, one Canada jay, and three unidentified birds were observed, presumably killed by automobiles. These mortality figures are certainly not excessive, but they do cause one to speculate as to their possible significance.

There is a tendency to consider highway deaths as indicative of the abundance of species, at least where the road traverses a uniform type of habitat. However, my trapping efforts during this period (748 trap-nights, with seventy-six individuals of ten species captured, but not all in roadside habitats) indicated a predominance of *Peromyscus* (37 per cent) and *Clethrionomys* (26 per cent) in the small mammal population, a situation not reflected in the highway kill. Many variables doubtless contribute to this highway mortality. The amount of traffic, and its speed on the highway, should be considered. The diurnal or nocturnal habits of the victims have a bearing on the case. A large animal is far more likely to be observed than is a small one, but this alone cannot account for the disparity in numbers as between snowshoe hares and other mammals in my tally. The natural alertness and agility of the animals themselves should in some measure protect them against the traffic menace. One is tempted to attribute highway deaths simply to a low order of "intelligence" on the victim's part; and yet witness the three amphibians and reptiles

observed killed as against the sixty-two mammals. Surely the factors involved in highway mortality are complex, and we should hesitate to jump to conclusions without careful analysis of all the circumstances.—RICHARD H. MANVILLE, *Department of Zoology, Michigan State College, East Lansing.* *Received January 4, 1949.*

NOTES ON MAMMALS FROM RICHARDSON COUNTY, NEBRASKA

In July and August, 1948, a series of mammals was obtained in the eastern part of Richardson County, Nebraska. These were taken under the direction of Dr. Edson Fichter, Biologist, Fur Investigation, of the Nebraska Game, Forestation, and Parks Commission. The specimens have been deposited in the collection of the Wildlife Research Laboratory of the Game Commission at Lincoln, Nebraska.

Richardson County is situated in the southeastern corner of the state. It is bounded on the north by Nemaha County, on the east by the Missouri River, on the south by Kansas, and on the west by Pawnee County, Nebraska. This county has the lowest elevation in the state, 824 feet at Rulo, and the heaviest annual rainfall, approximately 31 inches. Richardson County, containing 35,000 acres of native timber land, is transitional between the eastern hardwood forests and the western grasslands. This variable habitat is partly responsible for the wealth of flora and fauna existing within its borders. Some of the dominant trees are: black walnut, hickory, basswood, white elm, burr oak, paw paw, honey locust, and ash.

The southeastern part of the county, in the vicinity of Rulo, was extensively trapped in an effort to obtain the pine mouse (*Pitymys nemoralis*) and the cotton rat (*Sigmodon hispidus*), but only the former was taken. In the course of this field work many other mammals were observed or obtained. Jean Linsdale (Jour. Mamm., Vol. 9: 140–46, 1928) reported on a collection of mammals from the Missouri River Valley in Doniphan County, Kansas, about twenty miles south of Richardson County, therefore, detailed notes are recorded on only a few species. All measurements are in millimeters.

Sciurus carolinensis carolinensis Gmelin. Gray squirrel.—According to residents in the vicinity of Rulo, the gray squirrel was once numerous in the deciduous woodlands of the Missouri and Nemaha river valleys. It has apparently been hunted to the point of extermination within the borders of the state. The only record from Richardson County is provided by an individual shot at Barada in 1939 by Fichter; because of a diseased condition it was not saved. The forested areas near Rulo have abundant stands of mature walnut, oak, and hickory and should provide a suitable habitat for the return of this animal.

Perognathus hispidus spilotus Merriam. Hispid pocket mouse.—A single specimen was live-trapped in a roadside ditch five miles southeast of Rulo, approximately 100 yards from the Missouri River, on August 20. The trap was set slightly above the flood plain at the base of a steep, timbered bluff. The specimen, an immature male, has been referred to *P. h. spilotus* by Dr. Rollin H. Baker of the University of Kansas Museum of Natural History, in which collection the specimen is deposited. This is the first record of this subspecies taken in Nebraska. Measurements are: total length, 184 mm.; tail, 95; hind food, 26; ear, 13.

Peromyscus leucopus noveboracensis (Fischer). White-footed mouse.—This mouse is abundant in the forest and forest-margin areas southeast of Rulo. It is especially numerous on the wooded slopes bordering small tributaries of the Missouri River. Several individuals were trapped on sparsely vegetated and weathered rocky outcrops flanking the river. Two females measure: total length 188 mm., 178; tail 81, 76; hind food 22, 21, respectively. Three males measure: total length 180 mm., 180, 186; tail 80, 84, 86; hind food 22, 22, 22.

Pitymys nemoralis (Bailey). Pine vole.—The pine vole occurs in the deciduous forests along the Missouri River in southeastern Nebraska; previous to this year only seven individuals have been taken from the state. Vernon Bailey obtained six animals at London, Nemaha County, in 1895, and a flat skin in the collection of the University of Nebraska State Museum was taken at Barada, Richardson County, in 1939. Baker, of the University of Kansas Museum of Natural History, trapped two pine voles on a timbered bluff five miles

southeast of Rulo on August 20. These animals, both males, measure: total length 139 mm., 127; tail, 27, 25; hind foot, 19, 18; ear, 12, 12; respectively.

Zapus hudsonius campestris Preble. Meadow jumping mouse.—A jumping mouse was caught by hand in a roadside ditch approximately 150 yards from the Missouri River, five miles southeast of Rulo, at 8 P.M. on August 4. This ditch, bounded on one side by the road and on the other by a steep bluff, was intermittently wet and dry for almost five miles along the river. The mouse was kept alive until the following day. The specimen, an immature female, measured: total length 172 mm.; tail, 117; hind foot, 25.

Additional mammals recorded from the area include *Didelphis virginana virginana*, *Scalopus aquaticus machrinoides*, *Lasiurus borealis borealis*, *Taxidea taxus taxus*, *Marmota monax bunkeri*, *Sciurus niger rufiventer*, and *Mus musculus* subsp.

In late November, 1947, E. L. Cockrum, David C. Gordon, and R. B. Finley, all of the University of Kansas Museum of Natural History, obtained mammals six miles west and four miles west of Falls City. Mammals taken by them, but not represented in our collections, are: *Blarina brevicauda brevicauda*, *Microtus ochrogaster ochrogaster*, *Peromyscus maniculatus bairdii*, and *Reithrodontomys megalotis dychei*.—J. KNOX JONES, JR., AND OLIN L. WEBB, *Nebraska Game, Forestation, and Parks Commission, Lincoln, Nebraska. Received January 21, 1949.*

THE OCCURRENCE OF THE MOUNTAIN LION IN NEBRASKA

Although the mountain lion (*Felis concolor*) is now extinct within the borders of Nebraska, it was at one time found in small numbers in the state. It occurred throughout the pine ridge area in the northern part of the state and occasionally ranged south and eastwardly along many of the larger streams. Two definite records are available from Nebraska, one a skull of an adult female from Hay Springs, Sheridan County, and the other, a mounted specimen from Valentine, Cherry County. The specimen from Hay Springs was shot in the winter of 1884 while accompanied by two cubs. The skulls were presented to Mr. Louis Sessions of Norfolk, Nebraska, who gave the adult to the University of Nebraska State Museum. The present whereabouts of the skulls of the two young are unknown. The mounted animal was shot in 1880 by a boy at the mouth of a canyon near Valentine. Mr. Sessions also obtained this specimen for the university collection. Both of the above records were reported by Myron H. Swenk in 1907 in the Proceedings of the Nebraska Academy of Science. Swenk also states that mountain lions were reported in southern Holt County as late as 1899.

Mrs. O. R. Bowen of Wayne, Nebraska, reports to the author that her father, a pioneer doctor at Franklin, Nebraska, saw a mountain lion along the Republican River, south of Franklin, about 1888. If true, this indicates that these animals ranged into extreme southern Nebraska and northern Kansas, as Franklin is only seven miles from the Kansas border. —J. KNOX JONES, JR., *Nebraska State Game Commission, Lincoln, Nebraska. Received November 24, 1948.*

NOTES ON THE RACCOON (*PROCYON LOTOR HIRTUS*) IN MANITOBA

On February 9, 1948, a farmer living near Delta, Manitoba, Canada, brought two raccoon carcasses to the local Game Guardian, Mr. William Newman of the Manitoba Game Branch. The farmer did not know what the animals were, saying that he had shot them out of the trees in his pasture.

On this day the highest temperature was about 4°F. and the lowest was −24°F. Such extreme cold had prevailed for several weeks. The crusted snow was about eighteen inches deep in the groves, locally known as "bluffs," in the middle of the bare prairie where the raccoons had been shot. Undergrowth was sparse, owing to heavy grazing.

Upon investigating the small grove where the farmer had killed the raccoons, Game Guardian Newman and I found another raccoon sixteen feet above the ground in a small bur oak. It was clinging to the trunk. When we approached it did not move, but opened its eyes and looked sleepily down at us. Upon being forced from the tree the raccoon ran

to another bur oak and climbed into a small hole at its base, so shallow that it accommodated only three quarters of its body. Half of its tail appeared to have been frozen off.

In an area about 100 yards square these three raccoons had apparently spent a good part of the winter, digging through two feet of crusted snow to obtain food. The area was dug up in the same manner in which hogs root up the earth in search of acorns or grubs. The extent of these diggings indicated that the raccoons had been here for several weeks.

At the bases of four large boxelder trees, none of which were hollow, were piles of purple tinted droppings. The size of these piles, well over a foot high, indicated that the raccoons had been close to the spot for most of the winter. No open holes or hollow trees large enough to accommodate the raccoons were available in this "bush." In four places small hollows had been made at the bases of boxelder trees. These hollows were all too small for hibernation and would leave most of a raccoon's body exposed to the cold. They resembled rabbit forms more than they did raccoon dens.

It seemed possible that these raccoons might have been forced out of a denning place somewhere in the vicinity. A search of the area, however, revealed no evidence of this.

Both of the animals turned in were males, weighing, respectively, 7 pounds, 3 ounces and 7 pounds, 5 ounces. Of the first animal Mr. E. T. S. Norris-Elye, Director of the Manitoba Museum, says, after examining the skull (letter dated November 7, 1948): "I am confident that it is a young and probably immature; there is no sagittal crest, the cranial sutures are not yet fused, the post-orbital processes are underdeveloped there is no ridge between the nasals and the frontals as are found in old specimens." The third animal which we left alive in the bush appeared to be about the same size as the two which were killed. It seems likely that all three animals were young. The two dead animals carried only a small amount of fat, but appeared healthy. Their fur was prime.

According to recent investigators, the raccoon, although not a true hibernator, is asleep during the most severe parts of the winter. Thus Stuewer, writing of the raccoon in Michigan (Ecol. Mono., 13: 203–258, April, 1943) says, "During the coldest, most severe time of winter, the animals are curled up in their dens asleep. . . ."

As to the occurrence of this mammal in Manitoba, Soper (Jour. Mamm., 27: 136, 1946) says, ". . . Once ranged widely and rather commonly over southern Manitoba, but is now rarely met with and in many districts has become exterminated." Seton (Lives of Game Animals, 1929) says of its occurrence in this same area, "It is still found in southwestern Manitoba, but is exceedingly rare." Tracks of a raccoon were seen at Delta in 1939 by Aldo Leopold. One young raccoon was found dead in the Delta marsh in August, 1940, by H. Albert Hochbaum and Robert McClanahan.

In questioning local residents we have found only about one out of twenty-five who have ever seen a raccoon, and the few people who have tell of stragglers coming to the larger prairie "bluffs" or of seeing them in the Assiniboine river valley. The raccoons here described were found at a point fifteen miles from the Assiniboine river.

Seton gives four records of raccoons being taken in Manitoba farther north than this record and numerous records from the region of the Assiniboine and Red River valleys. Mr. E. T. S. Norris-Elye (letter, April 12, 1948) tells me of four raccoons he has record of from southern Manitoba during the past four years. He also says of a record about 400 miles north of Delta: "One is supposed to have been taken near Grand Rapids, Lake Winnipeg during the winter of 1943–44 and sold to Fred Kerr at The Pas."

From all of the past records we learn that the raccoon reaches the northern limit of its range in the region of southern Manitoba, seldom reaching farther north than the region of the Assiniboine and Red River valleys. This occurrence of three raccoons at Delta, Manitoba, during extreme weather coincided with a population "high" throughout the middle-western United States.—Lyle K. Sowls, *Delta Waterfowl Research Station, Delta, Manitoba, Canada.* *Received November 29, 1948.*

EXTENSION OF RANGE OF THE AFRICAN BAT, *MYOTIS BOCAGEI CUPREOLUS* THOMAS

The Chicago Natural History Museum has recently received two specimens of *Myotis bocagei cupreolus* Thomas collected at the Firestone Plantation, near Harbel, Liberia, in June, 1946, by Mr. Harry A. Beatty. The specimens are in alcohol and are slightly redder and smaller than topotypes. This race was described from Efulen, Cameroons, in the Lower Guinea Forest, and has been recorded from Bafwabaka, Medje, Belgian Congo. This Liberia record from the Upper Guinea Forest extends the range much farther west. A series of skins might show a recognizable color difference.

Regarding the capture of these bats, Mr. Beatty has sent the following note.

"These small and solitary bats are difficult to collect in their chosen habitats. In pairs, they pass the daylight hours clinging to broad leaves in the dark damp undercover in thickly overgrown swamps.

"My 2 specimens were flushed from the sheath of a water arum flower stalk at the edge of a swamp. Fortunately, they flew a short distance to another stalk and it was interesting to see them pitch headlong into the sheath. I worked my way very cautiously to their refuge and swiftly dropped an insect net over it. This must have been rather an exceptional instance in choice of hiding place as I never again saw bats in arum sheaths. The sheaths are about 12–15 inches high by 4 inches diameter, small opening at top, on stalks 3–4 feet tall."—COLIN CAMPBELL SANBORN, *Chicago Natural History Museum, Chicago 5, Illinois. Received November 2, 1948.*

THE STATUS OF *AKODON ANDINUS POLIUS* OSGOOD

The Peruvian mouse, *Akodon andinus polius*, was described by Dr. Osgood in 1944 (Field Mus. Nat. Hist., Zool. Ser., vol. 29: 196) from Salinas, Department of Arequipa, Peru. Later it was compared with the type of *Akodon lutescens* Allen, 1901 (Bull. Amer. Mus. Nat. Hist., vol. 14, p. 46), from Tirapata, Department of Puno, Peru. Dr. Osgood concluded that *polius* should be a synonym of *lutescens* which was a subspecies of *andinus*. He left notes to this effect with specimens identified as *polius*. The type locality of *Akodon andinus lutescens* Allen is about 200 miles northeast of Salinas, type locality of *polius*, and 1,000 feet higher.—COLIN CAMPBELL SANBORN, *Chicago Natural History Museum, Chicago 5, Ill. Received December 1, 1948.*

A SECOND SPECIMEN OF *MUSTELA VISON EVERGLADENSIS* HAMILTON

In September, 1948, Hamilton (Proc. Biol. Soc. Wash., 61: 139–40) described a new mink from the Everglades of southern Florida. His description is based on a single specimen, a female, apparently the only specimen known at the time of his writing, which was collected on the Tamiami Trail (U. S. Route 94), five miles southeast of Royal Palm Hammock, Collier County, Florida. In the mammal collection of the University of Miami, Coral Gables, Florida, is a second specimen which came into the writer's hands in November, 1947. In view of the rarity of this mammal, and because of the condition of Hamilton's specimen, it seems advisable to make available information concerning the Miami specimen.

This second specimen of *Mustela v. evergladensis*, a male, number 73 of the University of Miami collection, was trapped by Homer Rhode, Jr., one and one-half miles west of Carnestown, Collier County, Florida. Carnestown is at the intersection of the Tamiami Trail and state route 29, and four miles north of the city of Everglades. This locality is about six and one-half miles east of Hamilton's locality record. At the time of collection, Mr. Rhode was game warden in this area. The habitat of the region is one of coastal marsh, with scattered cypress and, in the wetter portions, dense mangrove growth. After the animal was collected, it was brought to Miami and placed in a deep-freeze at the establishment of Al Pfleuger, local taxidermist. The writer received the eviscerated mink carcass from Pfleuger

through the courtesy of Luis Rene Rivas of the staff of the zoology department of the University of Miami.

The measurements of the eviscerated specimen are, in millimeters: Total length, 609; tail vertebrae, 171; hind foot, 63; ear from notch, 22. The skull, which Hamilton indicates is badly crushed in the Cornell specimen, is not perfect in the Miami specimen. There is a crack running from the right antorbital process of the frontal posterolaterally to the left squamous region of the temporal. The inner face of the right orbit is missing, and from here a crack extends on the ventral surface of the skull to the inner margin of the left tympanic bulla. Right upper incisors 1 and 2, and the two innermost incisors of the mandible, are missing. Measurements of the skull are: Greatest length, 66; condylobasal length, 65; basal length, 62; palatal length, 32; postglenoid length, 28; mastoidal breadth, 36; zygomatic breadth, 40; length of mandible, 38; length of upper molar row, 19; length of lower molar row, 22.1. The baculum measures 38.3; the distal half has a deep sulcus, and the tip is recurved for a distance of 5 mm.

The pelage is dark and silky, the distal half of the tail being darker brown than the body. The chin has the typical white spot, in contrast to the Cornell specimen. The Miami specimen lacks the white scattered hairs on the dorsum of the neck; Hamilton suggests that these are due to age in his specimen.

It is apparent from the above data that in *Mustela vison evergladensis* the male is noticeably larger than the female, and that the male possesses a white chin patch. As Hamilton states, it is probably highly restricted in range to the coastal area near Everglades in Collier County, showing a preference to mangrove and cypress marsh habitat.—ALBERT SCHWARTZ, *Zoology Department, University of Miami, Coral Gables, Florida.* *Received December 2, 1949.*

THE TYPE SPECIMENS OF THE PRIBILOF FUR SEAL, *CALLORHINUS ALASCANUS* JORDAN AND CLARK

When David Starr Jordan and George A. Clark (The Fur Seals and the Fur Seal Islands of the North Pacific Ocean, Part 1, p. 45, 1898; *idem.*, Part 3, p. 2, 1899) described *Callorhinus alascanus* they neglected to designate a type specimen. While the author was working with the mammal collection of the Natural History Museum of Stanford University, skins, skulls, and skeletal material of *Callorhinus alascanus*, the Pribilof fur seal, were discovered. This material was collected by Jordan and Clark from the Pribilof Islands. It formed at least part of the collection of specimens which the authors had at their disposal when naming their new species. In view of the fact that Jordan and Clark did not designate any types, and that some of the material they used is, at present, in the collection of the Stanford Natural History Museum, it is deemed advisable to designate a lectotype from the specimens at hand, so that future workers will be able to cite definite specimens upon which *Callorhinus alascanus* was described, even though the name has been placed in the synonymy of *Callorhinus ursinus cynocephalus* by G. M. Allen (Amer. Comm. for Internat. Wild. Protect., Washington, D. C. Spec. Pub. No. 11, pp. 444–447, 1942). Relative to this work by G. M. Allen, Dr. G. S. Myers offers the following nomenclatural note: "Jordan and Clark give two separate diagnoses of *alascanus* in the Fur Seal Reports (1898, p. 45; 1899, p. 2). The first of these must stand as the original description, since it mentions distinguishing characters. However, G. M. Allen (1942, p. 445) is in error in crediting the first description to Jordan alone. Jordan and Clark were the authors of this section of the report, as well as of the more extended formal description of 1899."

The specimen designated as a lectotype is a female, number 4455, collection of the Natural History Museum of Stanford University. It was collected by Jordan and Clark in the Pribilof Islands during their Fur Seal investigations in 1896–1897. This is a mounted skin in perfect condition.

In addition to the lectotype, there are four other mounted skins belonging to the same collection, No. 4456, a young male pup; No. 4457, a three or four year old male; No. 4497, a young albino; and No. 4498, unsexed. There is also a series of eleven skulls and some skeletal material which was available to Jordan and Clark when they described *alascanus*.

In checking the skull measurements against those taken by Allen (U. S. Geol. and Geogr. Surv. Terr., Misc. Publ. No. 12: 323, 1880), the greatest breadth at the zygomatic arch was found to be consistently greater than the breadth at the mastoid process. This is the opposite of the situation recorded by Allen and it is believed that the two columns of figures were inadvertently transposed in Allen's table. Also, while Allen records no measurement of the depth of the lower jaw at the coronoid process in excess of 33 millimeters, the measurements of this author are consistently larger, and in no way can be made to agree with those taken by Allen.

The author wishes to thank Dr. G. S. Myers of the Stanford Natural History Museum, whose extensive knowledge of the collections made it possible to determine the material available to Jordan and Clark.—William V. Mayer, *Department of Zoology, University of Southern California, Los Angeles, California.* *Received December 10, 1948.*

RAISING CAPTIVE MEADOW VOLES (*MICROTUS P. PENNSYLVANICUS*)

The increased scope of present day medical research has, perforce, led to the introduction of many new techniques and procedures. Consequently, the search for suitable subject material for test purposes has been intensified. Variations in the physiological mechanisms of mammals require the use of many species for various problems in laboratory research.

The rodent now, as in the past, is favored for ease of manipulation, adaptability to environmental conditions, minimum space requirements and comparatively inexpensive methods of feeding. One of the members of this family, *Microtus pennsylvanicus pennsylvanicus*, has been found suitable for research involving the vole strain of microbacillus tuberculosis. It was for this purpose that the present colony was started at the National Institute of Health.

Selle (Jour. Mammalogy, vol. 9: 93–98, 1928) has reported on the raising of *Microtus californicus* in captivity and has presented some data on litter sizes and weights of young animals at birth and average weights during growth. Bailey (Jour. Agric. Res., 27 (8): 513–36, 1924) has reported on the caged raising of meadow voles, but there seem to be no available statistics concerning the comparative litter sizes of these animals when raised in captivity. The beneficial effects of an adequate diet may possibly be offset by the rodents' apparent lack of freedom. Table 1 shows the results observed among a colony that has been cage raised for two years and four months.

TABLE 1.—*Comparison of litters in Microtus*

LITTER ORDER	NO. OF LITTERS	NO. OF YOUNG	LITTER SIZE					LITTERS EATEN	LITTERS DIED	STANDARD DEVIATION	COEFFICIENT OF DISPERSION
			Min.	Max.	Mode	Median	Av.				
1	88	293	1	7	3.0	3.0	3.33	1	5	1.59	47.7
2	80	289	1	8	3.0	3.0	3.61	1	4	1.89	52.4
3	68	260	1	8	4.0	4.0	3.82	0	5	1.88	49.2
4	51	196	1	8	4.0	4.0	3.84	0	3	1.84	47.9
5	41	157	1	9	2.0	3.0	3.83	1	4	2.19	57.2
6	33	125	1	8	2.0	3.0	3.79	0	1	1.18	31.1
7	17	67	1	8	5.0	4.0	3.94	0	1	1.51	38.3
8	9	44	2	8	—	5.0	4.89	0	1	1.91	39.1
9	6	29	2	9	—	4.5	4.83	0	0	2.11	43.7
10	6	24	2	6	—	4.0	4.00	0	0	1.41	35.3
11	5	19	1	9	3.0	3.0	3.80	0	0	2.71	71.3
12	5	20	2	6	—	4.0	4.00	0	0	1.41	35.3
13	3	10	1	6	—	3.0	3.33	0	1	4.02	120.7
14	2	9	4	5	—	4.5	4.50	0	0	—	111.0
15	1	4	4	4	—	—	4.00	0	1	—	—
16	1	2	2	2	—	—	—	0	1	—	—

This colony was begun in January, 1945, for the purpose of supplying suitable material for research involving the vole strain of microbacillus tuberculosis. Foundation stock consisted of two females and two males obtained from Mr. E. P. Walker of the Smithsonian Institution, and three females and three males through the courtesy of Dr. D. R. Coburn of the Fish and Wild Life Service. Water was available at all times by means of a bottle and glass tube. Feeding was maintained ad libitum and consisted of a rabbit pellet prepared according to National Institute of Health specifications and supplemented with kale, apples, and carrots.

Prepared pellets consisted of the following ingredients:

15 per cent pure oat groats
30.5 per cent pulverized whole wheat (No. 1)
40 per cent alfalfa leaf meal, U. S. No. 1
13 per cent soy bean oil meal containing not less than 44 per cent protein
.25 per cent irradiated yeast
.25 per cent sodium chloride, iodized
1 per cent calcium carbonate

To the above is added 8 ounces (by weight) of cold pressed wheat germ oil per ton of feed.

In this colony, 416 litters were observed with the number of young totaling 1548. Average litter size was 3.72 with a coefficient of dispersion of 0.504, and standard deviation of 1.88. The table indicates that the average size increases to approximately the fifth litter, and then commences to decline. Erratic results in subsequent litters may be attributed to small numbers and consequent variability. Blank spaces indicate insufficient number of readings for a significant conclusion.—SAMUEL M. POILEY, *U. S. Pub. Health Service, Nat. Inst. Health, Bethesda, Md.* *Received February 2, 1949.*

AN EARLY REFERENCE TO THE CALIFORNIA POCKET GOPHER

There appears to be a reference to the California pocket gopher in "Cosmography . . . of the Whole World . . . . by Peter Heylin . . . London . . . 1682. Lib. IV. California . . ." p. 105.

"The Countrey is abundantly replenished with Herds of Deer, grasing upon the Hills by thousands: as also with a kind of Conies, in their Feet somewhat like a Want [mole], & on each side a Sack, where they keep such Victuals as they cannot eat."—CHAPMAN GRANT, *San Diego, Cal.* *Received January 4, 1949.*

REVIEWS

Murphy, Robert Cushman. LOGBOOK FOR GRACE. New York: Macmillan Company, 8vo, Pp. x + 270, text figures and map. 1947. Price, $4.00.

This book, a travel account almost entirely devoted to natural history, and including observations on Cetacea, particularly pilot whales (blackfish) and sperm whales, as well as sea elephants and birds, deserves the attention of readers of the Journal. The trip logged was through the central and southwestern Atlantic Ocean from about 35°N to South Georgia Island, about 55°S in the subantarctic, and was made on the whaling brig "Daisy" from July, 1912, to April, 1913.

Dr. Murphy, now Curator of Birds at the American Museum of Natural History, was then, 1912, a budding naturalist fresh out of Brown University and about to be married to Miss Grace Emeline Barstow "of the State of Rhode Island and Providence Plantations." The postgraduation marriage plans seemed about to be blasted by the sudden opportunity for the groom to travel and collect on the brig "Daisy," but the bride rose to the occasion by advancing the date of the wedding so that the two were married, took ship to the Lesser Antilles to join the "Daisy," and then parted for almost a year after a honeymoon of a little over four months. In gratitude, Murphy wrote a logbook to his Grace. He carefully made it in duplicate and forwarded a copy to her from whatever port he called during the voyage. After 25 years, this logbook has been worked over into a book which, though it still contains some endearing passages of a recent groom to his bride, and some discussion of literature, art, and other similar subjects, is mainly a well-written piece of natural history.

Murphy signed as member of the crew of the "Daisy," as assistant navigator to be exact, but his expressly assigned duties, duly noted in writing and known only to himself and the skipper, were to make collections of all specimens of natural history possible, with full observations and notes. This he did well, despite some absence of co-operation on the part of the skipper who received payment from the Museum to render such help. Murphy received more help from some of the harpooners and sailors.

The brig "Daisy" of 383 tons was one of the last of the famous New Bedford sperm whaling fleet, and was making an annual voyage to the Atlantic for blackfish and sperm whales and to South Georgia for sea elephant (all for oil). It carried 34 men, most of whom were negroes, mulattos, and Portuguese from the Azores; all were deep-water sailors, and some were magnificent men.

First hand observations of old time whaling and of cetaceans in general by a qualified naturalist of modern education and of ability to work, see, and write, are exceedingly rare. Herein lies the value of the book for zoologists. The many observations of pelagic birds and penguins have been recounted in Murphy's "Oceanic Birds of South America" (2 volumes, American Museum of Natural History, New York, 1936; Macmillan Company, New York, 1948), and many of the notes on sea elephants have been published in the Bulletin of the American Museum of Natural History (New York, vol. 33, art. 2, 1914), but this is the first time as far as I know that many of his authentic observations on sperm whaling, pilot whale capture, and porpoises and dolphins at sea have seen the light. The figures in the book do not apply materially to natural history or to art; they were drawn by Murphy himself to make more intimate the logbook for his Grace. He took many excellent photographs which could have been used, and very instructive they would have been—I have seen them, unpublished as well as published.

Murphy's observations on mammals in LOGBOOK FOR GRACE may be divided into three main headings: (1) the whaling of pilot whales (blackfish) off the Lesser Antilles and in the adjacent Atlantic, July to September 1912; (2) the taking and processing of sperm whales wherever found in the middle Atlantic; (3) the hunting and processing of sea elephants for oil on South Georgia Island. Of the many points of interest, I will discuss only a few. The reader interested in more will have to read the book—a statement to be taken literally because there is no index.

It was not apparent to me, before reading this book, what a large part the old-time sperm-

whalers played in the fishery of pilot whales as an off-time business. However, it is evident that the sperm whaler's harvest of the pilot whale supplied a good deal of the watch oil of the early days, as well as regular blubber oil, and some meat which when dried was sold or bartered in the West Indies, or when still fresh was eaten on board to augment and relieve the monotonous ship's supplies. The fishery also supplied valuable practice for neophyte whalers, an important consideration. The reasons for any such fishery at all were probably that blackfish could be encountered in large schools and were of appreciable size (15 to 24 feet or so); also they generally insured a fair yield of head and blubber oil. Today the offshore pilot whale fishery is gone; pilot whales are taken only near shore, either by driving on the beach, as at the Faroes and Greenland, or after naturally stranding in numbers, as at Cape Cod.

Dr. Murphy mentioned the eating of sperm whale meat aboard the "Daisy" with the comment that it was edible and a welcome relief from regular ship's fare. He ate meat from young and old sperm whales, and meat mixed with fish. The edibility of sperm whale flesh is a controversial subject, and some people have stated that it is completely indigestible. The lack of agreement seems to the reviewer to lie in a natural variability of sperm meat, some being more edible than others. A reason for this, besides age and sex of the whale, may be in the amount of glycerides in the oil as against the waxy esters which predominate in sperm oil, and this may relate directly to food (all squid, all waxy oils? some fish, some glycerides?).

Another point of interest not detailed by Murphy was the observed presence several times of killer whales in a school of sperm whales without any noted predation of killers on the latter. More on this point by Murphy would have been valuable. Killer whales usually are considered as ruthless butchers and wolves of the sea; but, even though their attacks on larger whales are rarely seen, i.e., the many stories are hard to substantiate, their innocuous association with sperm whales would be interesting.

An observation by Murphy, of extreme interest, is the ability of a pilot whale to "let go," or suddenly sink down through the water without any evidence of swimming or inclination of the body. A pilot whale is heavier than water to begin with, and though Murphy made no explanation of this phenomenon, it is evident that this species is able to stay at the surface only by slight swimming motion of flippers and flukes and/or constant partial inflation of the lungs so that to "let go" might involve merely cessation of such movements to maintain position at the surface. But this phenomenon is also reported for sperm whale, and I believe for right and bowhead whales, most individuals of which (especially sperm) are lighter than water, and hence must be able to increase their specific gravity to "let go." It is a subject of importance but without, as far as I know, any scientific explanation. Murphy is one of the few qualified observers who has seen the phenomenon.

A point seldom elucidated in books on whaling or in accounts of the industry, is the search for ambergris in a sperm whale. Murphy adequately describes this operation; the belly of the flensed carcass was opened in the water and the entrails were perforated with a sharp, long-handled flensing spade by the captain and the mates (it was an important job), and the blade was smelled and scrutinized for some tell-tale sign of the precious waxy intestinal obstruction which has such valued use in the perfume industry as a musk with fixative powers.

It is evident, from this account of deep sea, hand whaling of sperm whales, that scientific information was difficult to come by. Young and old sperm whales of both sexes were taken in numbers, but the carcasses lay in the water where they were flensed of blubber and then cut loose to sink. Hence, no measurements or anatomical parts were easily taken or collected by Murphy or others. In the more recent times of scientific research, sperm whaling has not been as extensive as formerly, and little biological knowledge has been forthcoming from the major sperm whaling centers of Japan, the Azores, and the west coast of South America. Efficiency has become more and more "the word," with little time to "fool around" with biological research. Since 1939, the minimum size length for sperm whales has been 35 feet, with 30 feet permitted to those taking them for local human or animal consumption of the meat. A 30-foot limit allows a number of females to be taken, but a 35-foot limit eliminates probably 90 per cent of the females from the catch (females rarely grow as large as 40 feet,

whereas males grow to 60 feet). Today (1949) the limit is 35 feet without any exception. Hence, the time probably is gone for extensive biological observations to be made easily on the reproduction and growth of the sperm whale, and the anatomy of the females.

Another item: Murphy saw a school of beaked whales at sea. They played around the ship at dizzying speed and then left. The captain called them "algerines," implying a vague acquaintance. So rare are observations on the ziphoid (beaked) whales at sea that readers of whaling journals and similar yarns should be sharp for the word "algerine"; it's new to my lexicon too.

I have not yet read my quota of whaling books (there are a great many published), but of the few thoroughly perused, Murphy's is in the top bracket.—RAYMOND M. GILMORE.

Troughton, Ellis. THE FURRED ANIMALS OF AUSTRALIA. New York: Charles Scribner's Sons, Pp. xxvii + 374, 25 colored plates (by Neville W. Cayley), 8vo, cloth. 1947. Price, $5.00.

The appearance of an American edition of Ellis Troughton's already classical work on Australian mammals is an event of importance to mammalogists in this country. The original edition of 1941 (reviewed by Hall, Jour. Mamm., vol. 4, pp. 105–106, February, 1943) is long out of print, and successive editions by the Australian publishers were so limited by restrictions resulting from paper shortages that few copies reached the United States.

As one who has tested the book both in the museum and in the field, this reviewer can find little about it to criticize. Supplemented by Iredale and Troughton's check list (Mem. Australian Mus., no. 6, pp. 122, May 4, 1934), it provides an introduction and also a thorough guide to the native Australian fauna so far as it is known. The deficiencies result from the dearth of information on all but a few of the Australian species, rather than to any failure on the author's part to sift and digest the published literature. It may be added that the book has unusual literary merit.

It is important for systematic mammalogists to know that the present American edition, except for the publisher's imprint and the date, is a direct reprinting of the second (revised) edition published in Sydney by Angus and Robertson in November, 1943. The "new" chiropteran generic names *Registrellus*, *Falsistrellus*, *Scoteanax*, and *Scotorepens* and the amplified diagnoses of *Vespadelus* and *Micronomus* actually date, therefore, from the second Australian edition. This fact will also explain the absence of corrections beyond the year 1943. Still a third Australian edition, with some changes in the text, was published in November, 1946.

Being a sincere conservationist, Troughton records and laments the tragic decimation of the former Australian fauna, as caused by human exploitation of the land. He seems to overlook, however, the extraordinary implications of the introduced species that are shaping the mammalian fauna of the future. Brief accounts are devoted to that early arrival, the dingo, and to the more recently introduced rats, rabbits, and hares, but not to the well-established and biologically important "foreign" foxes, cats, deer, buffalos, ponies, donkeys, and camels. Perhaps these deserve a volume of their own.—DAVID H. JOHNSON.

Trippensee, Reuben Edwin. WILDLIFE MANAGEMENT, UPLAND GAME AND GENERAL PRINCIPLES. New York: McGraw-Hill Book Company, Pp. x + 479, 37 figs., 1948. Price, $5.00.

As the author indicates in his preface, this book is the first of two volumes summarizing progress in the field of wildlife management. Presumably, a second will be published covering furbearers, waterfowl, and game fishes.

There has been no book which adequately performs the service represented in the task to which Dr. Trippensee has set himself. The ramifications of the field are so broad and so varied as to intimidate the entrepreneur with less than full time to spend upon it. It is a commendable example that a teacher with the obligations attending such a position has found the spirit to carry such a job to, at least partial, completion.

The arrangement of a major portion of the material is by three land-use types: *Farm*

Wildlife, *Forest Wildlife*, and *Wilderness Wildlife*. Two additional major parts of the book are entitled *Miscellaneous Wildlife Relationships* and *Wildlife Administration*. This organization involves anomalies recognized by the author, such as the inclusion of the prairie chicken, sharptail, and sage grouse under *Forest Wildlife*.

A prodigious amount of library research has gone into the species accounts, which summarize the bulk of the most significant literature on game species of the east. That the treatment of western forms is somewhat less adequate reflects not only the personal experience of the author, but the fact that there is less published material from which to draw. The summaries of natural history and the excellent bibliographies will be useful to both beginners and advanced workers in the wildlife field. References are given by chapters and in a section on *General References* at the end of the book. As an example of the comprehensive treatment, there are 76 titles cited in the chapter on deer.

As a management text this work is somewhat less satisfactory. It is concerned almost entirely with how-to-do and seldom with when-and-where-to-do. It builds no clear-cut management philosophy. There is little to help the student to a better understanding of the economics and sound application of such measures as winter feeding, food patches, artificial restocking, and predator control. It is unfortunate that a more critical appraisal was not made of these widely misused techniques. The reader gets the impression in many places that the author is giving almost blanket endorsement to such things, yet contradictory statements will be found—especially in quotations from significant sources. Handling of the predator-control issue is particularly disappointing in the accounts of small game species.

The length of time involved in preparing a work of this kind makes it inevitable that in some aspects it will not be up to date. In the present case this feature appears in rather serious proportions. The account of *The Farm as a Wildlife Habitat* fails to emphasize modern land-use methods as the basis of wildlife management and does not make use of some of the most practical recent techniques: e. g., planted field borders, contour hedges, and living fences. In "A List of Perennial Cover and Food Plants Suitable for Farm Game," multiflora rose and bicolor lespedeza are not included. These have, perhaps, become the most important of all.

This book is a valuable contribution to wildlife management literature and one that should be widely useful if its wealth of facts are applied with an alert discrimination in the forming and teaching of policy principles.—Durward L. Allen.

Jaeger, Ellsworth. Tracks and Trailcraft. New York: Macmillan Co. Pp. vii + 381, 203 plates. 1948. Price, $3.95.

The book comprises sixteen chapters, acknowledgments, introduction, contents, and index. The chapters are arranged as follows: Fossil Tracks; The Indian and His Tracking; Scent Trails and Blazes; The Anatomy of Animal Tracks; Barnyard Tracks; Animal Tracks of Field and Forest (three chapters); Woodland Snowshoe Tracks; Tracks in Jungle and Zoo; Bird Tracks; Amphibian and Reptile Tracks; Crustacean, Mollusk, and Insect Tracks; Reproducing Tracks; and Tracking Games. To me the chapter on tracks in zoo and jungle appeared superfluous. The nine-page index is very good. Animals whose tracks are recorded in this volume are cross-indexed by scientific and common name. The acknowledgments are succinct and for the most part generous. The author's recognition of Ernest Thompson Seton as "the foremost authority on tracks" displays humility and therefore will command the respect of most naturalists.

The over-all treatment of the subject is light but not unscientific. Each species treated has a corresponding plate which is never far removed from the paragraph on the salient particulars of its natural history. For the most part these thumbnail sketches are accurate and helpful. Whether the nomenclature is that of the author or that of other taxonomists is not stated. Likewise it is difficult to tell where he has drawn on the works of others in the assembling of materials. There is no space given to references, and several are only briefly mentioned. A recitation of personal experiences would have stimulated interest and given the book added authority.

The chapter on "Scent Trails and Blazes" is weak and includes such captions as "Bird Sky Trails," "Insect Migration Trails," and "Spawning Trails," which appear to be unrelated to the chapter in which they occur.

The three-chapter treatment of "Animal Tracks of Field and Forest" is the best section of the book. One fault, however, is that there is no consistency in the information on gaits—some for no apparent reason are measured and drawn, while others are not.

The chapter on bird tracks is good, but no diagrammatic comparisons between any of the tracks are shown (pp. 240–241). Three herons and a bittern are each pictured with the same shaped track and represented by about the same size drawing. If the tracks had been drawn to scale the illustration and comparison would have been clearer. Also with the mammal tracks, a key would have added a great deal, particularly in pointing out the important differences between tracks that are likely to be confused. The treatment of bird tracks is much less exhaustive than is that of mammal tracks. Western gallinaceous birds especially have been slighted. It should be said, however, that very little work has been done with bird tracking and this book has recorded more bird tracks than any other with which I am familiar.

The chapters "Reproducing Tracks" and "Tracking Games" are very good and will be of interest to parents, educators, and recreation personnel.

The sketches are *à la* Seton, and for the most part quite good. The humorous illustrations on chapter headings are interesting and add a certain light touch. The simple line drawings are very effective, and the extra sketches on habitat and behavior enhance the track plates.

The mammal drawings looked strangely familiar. On checking I found that the author was apparently impressed with the artistry of Fuertes and Weber, for many of the illustrations appear to have been copied with very slight alterations (particularly the twist of the tail) from their colored paintings published in the NATIONAL GEOGRAPHIC MAGAZINE, and others from works of Seton. No mention is made of using the plates of these artists as reference. It is unfortunate since the author seems capable of originality in portraying animal posture and form.

Although opinions on the treatment of tracking and sign reading may differ, and despite minor shortcomings, I believe the book will have wide appeal. It can be readily adapted to teaching beginning students of natural history and can also be used as a reference for more advanced field workers. It is to my knowledge the best book of its kind on the subject. If the book were one dollar cheaper, it would reach a greater audience. Had it been made pocket size, it would have greater utility.—ROBERT A. MCCABE.

Orr, Robert T. MAMMALS OF LAKE TAHOE. California Academy of Sciences, San Francisco: Pp. 127. Illustrated by George and Patritia Mattson. 1949. Price, $4.00.

The title of this book is somewhat misleading. The accounts are not restricted to the aquatic mammals of Lake Tahoe, but include all the land mammals known to occur in the region immediately surrounding the lake. After a short historical account and description of the Lake Tahoe region, Dr. Orr follows with a brief discussion of the system of classification, for the non-biologist, and a key to the mammals included in the book. I am inclined to think that the amateur will thumb through the book and look at the illustrations, which are generally good, rather than try to use the key if he wishes to identify a mammal from the Lake Tahoe region.

In the species accounts, which make up the remainder of the book, except for a short glossary and list of general references at the end, the author gives an adequate description, a statement of general and local distribution, and a rather complete statement on the habits of each kind or group of closely related kinds. In the section on habits, Dr. Orr has drawn on his own observations as well as on those of others. Here, I believe, the reader will find new information scattered through the accounts.

The author chooses to use the Family Muridae instead of Cricetidae for the genera *Peromyscus*, *Neotoma*, *Phenacomys*, *Microtus*, and *Ondatra*. The common names used are for the most part short and appropriate. I would have preferred the use of *vole* instead of *mouse* for the microtines. He does use "Voles" for the main heading, but "mouse" thereafter.

The book is written in a semipopular style with scientific accuracy. The printing and book making are of good quality, and the result is an attractive as well as useful little volume that anyone should be proud to have on his shelves. The price undoubtedly will discourage many who otherwise might purchase the book.—WILLIAM H. BURT.

Ingles, Lloyd Glenn. MAMMALS OF CALIFORNIA. Stanford: Stanford University Press, xx + 258 pp., frontis., 47 pls., 57 figs. First printing, February, 1947; second printing, October, 1948. Price, $4.00.

The text of the second printing of this book is apparently unchanged from that of the first printing, but there have been minor changes in some of the illustrations. I can find no mention that these changes have been made, but close comparison with the first printing reveals changes in Figures 1, 2, 3, 4, 6, and 30. These, illustrations of skulls, have been redrawn and labelled in the second printing. In Figure 4, a drawing of a skull of a gray fox, the postorbital process of the frontal is labelled "zygomatic process" and the "angular process" of the mandible is directed to the wrong part of that element.

The photographs, especially those taken by the author, are mostly of excellent quality. Particularly good are those of the spotted skunk, ermine, kit fox, gray fox, pocket mice, pika, and brush rabbit. That of the kit fox is, in my opinion, the most outstanding of all. Reproduction is better than it was in the first printing. I am sure there are better photographs available for the marten, mink, and otters.

This book was "written for the student, for the aspiring naturalist, and for all others who want a better acquaintance with and knowledge of the interesting mammals of California." It is written in a semipopular style that makes it easy reading. After a short *Introduction* there is a section on *How to Study Mammals*. Here we find some suggested problems, but primarily this section tells how to use the book. It includes a general key. The third and main section is on *Accounts of the Species*. Short descriptions and general accounts on habits and distribution are to be found here for selected species of California mammals. The author is not concerned with subspecies. The omission of subspecies from this kind of book is justified in my mind. Small distribution maps, of California, are scattered through the book, as are detailed keys to the smaller groups. The author has incorporated habits and habitat preferences, as well as physical characteristics of the animals, in the keys—another good feature.

In the *Appendix* there is a condensed classification of the mammals of California and a section, illustrated, on how to collect and make up study skins. A rather complete Index is provided.

The book is attractively printed and is bound in cloth. My only criticism is that there is no *List of References* and one does not know, except in a few instances, who is responsible for much of the information. If there is to be a third printing I should like to see better documentation even though the book is not supposed to be a scientific treatise.—WILLIAM H. BURT.

RECENT LITERATURE

(Conducted by Gerrit S. Miller Jr., Remington Kellogg, and Emma M. Charters)
[Reprints of this section may be purchased from the Corresponding Secretary]

ADLER, S. Origin of the golden hamster *Cricetus auratus* as a laboratory animal. Nature, London, vol. 162, no. 4111, pp. 256–257. August 14, 1948.

AGAR, W. E., F. H. DRUMMOND, AND O. W. TIEGS. Third report on a test of McDougall's Lamarckian experiment on the training of rats. Jour. Exper. Biol., London, vol. 25, no. 2, pp. 103–122. June, 1948.

ALDEN, ROLAND H. Implantation of the rat egg. Amer. Jour. Anat., Philadelphia, vol. 83, no. 1, pp. 143–169, pls. 1–6. July, 1948.

ANONYMOUS. Big-game inventory of the United States. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Leaflet 303, pp. 13. 1948.

ANONYMOUS. Fur resources decline. Maryland Conservationist, Baltimore, vol. 25, no. 1, pp. 12–13, illus. Spring, 1948.

ANONYMOUS. Saving the buffalo. Beaver, Winnipeg, outfit 279, pp. 10–13, illus. June, 1948.

ANONYMOUS. Fauna and flora of Palestine. Nature, London, vol. 161, no. 4101, p. 902. June 5, 1948.

ANONYMOUS. What's new. San Diego Zoonooz, vol. 21, no. 7, p. 7. July, 1948. (Bactrian camel)

ANONYMOUS. Game killed during 1947 season. South Dakota Conserv. Digest, Pierre, vol. 15, no. 7, p. 5. July, 1948.

ANONYMOUS. Wyoming's deer, trophy game of the west. Wyoming Wild Life, Cheyenne, vol. 12, no. 7, pp. 5–11, 36–39, illus. August, 1948.

ANONYMOUS. Summary statement of bounties paid on predators during fiscal year, June 1, 1947 to May 31, 1948. Pennsylvania Game News, Harrisburg, vol. 19, no. 5, p. 13. August, 1948.

ANONYMOUS. Those peculiar anteaters. Our Dumb Animals, Norwood, vol. 81, no. 8, p. 9, illus. August, 1948. (Armadillo, Giant Anteater, Aard-vark)

ANONYMOUS. Outsmarted. Louisiana Conservationist, New Orleans, vol. 1, no. 1, pp. 2–3, illus. September, 1948. (Wolf killing sheep in Louisiana)

ANONYMOUS. Big game hunting outlook good. Colorado Conserv. Comments, Denver, vol. 10, no. 7, pp. 5–6, illus. September, 1948.

ANONYMOUS. New electric deer fence. Virginia Wildlife, Richmond, vol. 9, no. 10, pp. 23, illus. October, 1948.

ANONYMOUS. First winter browse study. North Dakota Outdoors, Grand Forks, vol. 11, no. 4, p. 6, illus. October, 1948. (Deer)

ANTHONY, J. Observations sur un encephale d'éléphant d'Asie fixé en position dans le crane. Ann. Sci. Nat., Paris, ser. 11, vol. 9, pt. 2, pp. 253–264, figs. 5. October, 1948.

ANTHONY, J. Le trou malaire des Atelidae et son intérêt dans la classification des singes platyrhiniens. Mammalia, Paris, vol. 10, no. 2, pp. 70–77, figs. 5. 1946.

ARCHDEACON, J. W., AND R. S. ALLEN. Some factors involved in food and water ingestion in the dog. Amer. Jour. Physiol., Baltimore, vol. 153, no. 1, pp. 27–30. April 1, 1948.

ASHBROOK, FRANK G. Fur—an important wildlife crop. Iowa Conservationist, Des Moines, vol. 7, no. 10, pp. 73, 79, illus. October 15, 1948.

ASHLEY, FRED W. Effect of ground contact on fur. Nat. Fur News, Denver, vol. 20, no. 7, p. 24. August, 1948.

ASTRE, GASTON. Lièvre blanc de Prat-Communal (Pyrénées de l'Ariège). Mammalia, Paris, vol. 10, no. 2, pp. 94–96. 1946.

ATKESON, THOMAS Z., AND JOHN L. HEFLIN. Wheeler squirrel hunt. Alabama Conservation, Montgomery, vol. 19, no. 10, p. 8. April, 1948. (Gray Squirrel)

ATWOOD, EARL L. National wildlife refuge objectives. Kentucky Happy Hunting Ground, Frankfort, vol. 4, no. 4, pp. 4, 25. July–August, 1948.

BACHMANN, ELIZABETH. Cagey badger. Conserv. Volunteer, St. Paul, vol. 11, no. 64, pp. 10–12. May–June, 1948.

BAILLIF, RALPH N. Ovarian response in the albino rat to injected colloidal substances. Amer. Jour. Anat., Philadelphia, vol. 83, no. 1, pp. 109–135, pls. 1–3. July, 1948.

BALLI, ANTONIO. Rapporto trapeso del fegato e peso corporeo in Talpa europea L. Atti Soc. Nat. & Math. Modena, vol. 71, pp. 165–185, tables 13. 1940.

BALLI, ANTONIO. Ricerche sull'accrescimento viscerale postnatale in Talpa europea L. Atti Soc. Nat. & Math. Modena, vol. 73, pp. 35–59, figs. 3, tables 7. February 22, 1943.

BANFIELD, A. W. F. A bedbug on a little brown bat. Canadian Field-Nat., Ottawa, vol. 62, no. 4, p. 126. July–August, 1948.

BARGER, N. R. Minnesota varying hare—snowshoe hare (*Lepus americanus phaeonotus*). Wisconsin Conserv., Madison, vol. 13, no. 9, pp. 24–25, illus. September, 1948.

BARGER, N. R. Gray wolf—timber wolf. Wisconsin Conserv. Bull., Madison, vol. 13, no. 10, p. 26, illus. October, 1948.

BARKER, ELLIOTT S. Antelope comeback. Field & Stream, New York, vol. 53, no. 4, pp. 26–27, 121–123, illus. August, 1948.

BARTLETT, I. H. Hunters and deer—1947–1948. Michigan Conserv., Lansing, vol. 17, no. 11, p. 3, figs. 2. November, 1948.

BASSETT, CHARLES F. Results of 13 years experiment in feeding mink. Black Fox Mag., New York, vol. 32, no. 3, pp. 10–11, 20. July, 1948.

BASSETT, CHARLES F. Some common fallacies in our present mink feeding practices. Fur of Canada, Winnipeg, vol. 13, no. 10, pp. 3–4, 6. July, 1948. Also in Nat. Fur News, Denver, vol. 20, no. 7, pp. 14, 34–38. August, 1948.

BASSETT, C. F., J. K. LOOSLI, AND FORD WILKE. The vitamin A requirement for growth of foxes and minks as influenced by ascorbic acid and potatoes. Jour. Nutrition, Philadelphia, vol. 35, no. 6, pp. 629–638. June 10, 1948.

BASSETT, CHARLES F., AND FORD WILKE. Poultry waste as mink feed. Nat. Fur News, Denver, vol. 20, no. 8, pp. 14, 34. September, 1948.

BENCHLEY, BELLE J. Wild animal pets. San Diego Zoonooz, vol. 21, no. 8, pp. 3–7, illus. August, 1948.

BERG, BENGT. Skall staten radda kronhjorten? Svensk Jakt, Stockholm, vol. 86, no. 7, pp. 162–166, illus. July 15, 1948.

BERRYMAN, JACK H. Series of articles presents interesting information concerning important mammals of Utah. Utah Fish & Game Bull., Salt Lake City, vol. 5, no. 12, pp. 3–5, illus. July–August, 1948.

BERRYMAN, JACK H. Facts of interest about Utah mammals. Utah Fish & Game Bull., Salt Lake City, vol. 6, no. 3, pp. 3–5. October, 1948. (Black and Grizzly Bears)

BERRYMAN, JACK H. Shrews are small and vicious but they're man's friends. Utah Fish & Game Bull., Salt Lake City, vol. 6, no. 1, pp. 6–8, illus. September, 1948.

BEVER, WENDELL. Danger signals in Black Hills. South Dakota Conserv. Digest, Pierre, vol. 15, no. 8, pp. 10, 16, illus. August, 1948. (Over-browsing of range by deer)

BLAIR, W. FRANK. Population density, life span, and mortality rates of small mammals in the blue-grass meadow and blue-grass field associations of southern Michigan. Amer. Midland Nat., Notre Dame, vol. 40, no. 2, pp. 395–419, figs. 2. September, 1948.

BODIAN, DAVID. Poliomyelitis in an uninoculated Rhesus monkey, and in orally inoculated monkeys, receiving desoxypyridoxine. Amer. Jour. Hygiene, Lancaster, vol. 48, no. 1, pp. 87–93. July, 1948.

BONNOT, PAUL, AND WILLIAM ELLIS RIPLEY. The California sea lion census for 1947. California Fish & Game, San Francisco, vol. 34, no. 3, pp. 89–92, illus. July, 1948.

Bossanyi, J. Notes on the keeping of a baby seal (Phoca vitulina). Proc. Zool. Soc. London, vol. 117, no. 4, pp. 791–792. February 3, 1948.

Bower, Ward T. Alaska fishery and fur-seal industries, 1945. U. S. Dept. Interior, Fish & Wildlife Service, Stat. Digest, no. 15, pp. 63. 1948.

Bowness, E. R. Mink growing season. Nat. Fur News, Denver, vol. 20, no. 4, pp. 13, 34, no. 5, pp. 12, 24. May, June, 1948.

Bowness, E. Rendle. Good nutrition, its importance and practical value. Black Fox Mag., New York, vol. 32, no. 1, pp. 10, 22; no. 2, pp. 15, 27–28; no. 3, pp. 12, 20. May, June, July, 1948.

Bowness, E. Rendle. Critical factors in shed construction. Fur of Canada, Winnipeg, vol. 13, no. 10, pp. 15–20. July, 1948. Also in Nat. Fur News, Denver, vol. 20, no. 7, pp. 15, 32; no. 8, pp. 21, 35–41. August, September, 1948. (Mink)

Bowness, E. Rendle. Importance, practical value of good nutrition. Amer. Nat. Fur & Market Jour., Wausau, vol. 27, no. 1, pp. 9, 25, 29–30; no. 2, pp. 12, 33, 37–38. August, September, 1948.

Boyer, Charles C. Development of the golden hamster, *Cricetus auratus*, with special reference to the major circulatory channels. Jour. Morphol., Philadelphia, vol. 83, no. 1, pp. 1–38. July, 1948.

Boyer, E. C. Nanook of Shugliak. Field & Stream, New York, vol. 53, no. 4, pp. 22–23, 119–121, illus. August, 1948. (Walrus, Greenland Whale, Polar Bear)

Bradt, G. W. Vanished mammals. Michigan Conserv., Lansing, vol. 17, no. 7, pp. 4–5, illus. July, 1948. (Wolverine, Fisher, Marten, Cougar, Lynx, Bison, Caribou)

Braekkan, Olaf R. Vitamins in whale liver. Hvalrådets Skrifter, Sci. Results Marine Biol. Research, Oslo, no. 32, pp. 1–25, figs. 4. 1948.

Bridgman, Jane. A morphological study of the development of the placenta of the rat. Jour. Morphol., Philadelphia, vol. 83, no. 1, pp. 61–80, pls. 1–3. July, 1948.

Brinck, Per. Valrossen i zoologiens historia. Zool. Bidrag, Uppsala, vol. 25, pp. 118–133, figs. 7. 1947.

Brinker, W. O. Blood studies in dogs following the injection of penicillin. North Amer. Veterinarian, vol 25, pp. 31–33. 1947.

Brinkmann, August, Jr. Studies on female fin and blue whales. Report on investigations carried out in the Antarctic during the season 1939–1940. Hvalrådets Skrifter, Sci. Results Marine Biol. Research, Oslo, no. 31, pp. 1–38, figs. 13. 1948.

Brown, G. L., B. D. Burns, and W. Feldberg. The effect of diisopropylfluorophosphonate on neuromuscular transmission in cats. Jour. Physiol., London, vol. 107, no. 3, pp. 346–354. June 25, 1948.

Brown, Percy. The Kneeling Nun lion! Outdoorsman, Columbus, vol. 90, no. 4, pp. 32–33, 66–67, illus. July–August, 1948.

Bruce, Stuart. Death of a masked raider. Outdoor Life, New York, vol. 102, no. 3, pp. 50–56, illus. September, 1948. (Raccoon)

Buntin, Howell. 178 deer released in state. Tennessee Conservationist, Nashville, vol. 13, nos. 7–8, p. 3. July–August, 1948.

Burr, J. G. A kind word for the coyote. Texas Game & Fish, Austin, vol. 6, no. 7, pp. 9, 14. June, 1948.

Burt, William H. [Review of] The California ground squirrel; a record of observations made on the Hastings Natural History Reservation, by Jean M. Linsdale. Science, n. s., Lancaster, vol. 104, no. 2705, p. 430. November 1, 1946.

Burtch, Lysle. Rabbits or chucks? Pennsylvania Game News, Harrisburg, vol. 19, no. 6, p. 28. September, 1948.

Butcher, Earl O. Adrenal auto-transplants in the hepatic portal drainage in the rat. Endocrinology, Boston, vol. 43, no. 1, pp. 30–35. July, 1948.

Buxton, P. A. Experiments with mice and fleas. Parasitology, London, vol. 39, nos. 1–2, pp. 119–124. July, 1948.

CADY, EARL R. Fur business in Tennessee. Tennessee Conservationist, Nashville, vol. 13, nos. 9–10, p. 4. September–October, 1948.

CAMP, CHARLES L. University of California African expedition—Southern section. Science, Lancaster, vol. 108, no. 2812, pp. 550–552. November 19, 1948.

CARLSON, ANTON J., AND F. HOUZEL. Prolongation of the life span of rats by bulk-formers in the diet. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 27–40. July 10, 1948.

CARLYLE, A. On integration of the total oxygen consumption of the sheep foetus from that of the tissues. Jour. Physiol., London, vol. 107, no. 3, pp. 355–364. June 25, 1948.

CARPENTER, GEORGE. Our vanishing moose. Rod & Gun in Canada, Montreal, vol. 50, no. 3, pp. 11, 42. August, 1948.

CARPENTIER, C. J. Remarques sur la morphologie du campagnol souterrain. Mammalia, Paris, vol. 10, no. 2, pp. 92–93. 1946.

CARR, WILLIAM H. Desert parade: a guide to southwestern desert plants and wildlife. Viking Press, New York, pp. 96, illus. 1947. (Treats of 29 mammal species; photographs by Marvin H. Frost)

CHADDOCK, T. T. Fatty degeneration of the liver in mink. Fur of Canada, Winnipeg, vol. 13, no. 8, pp. 3–4. May, 1948. Also in: Black Fox Mag., New York, vol. 32, no. 1, pp. 13, 28; no. 2, pp. 14, 26. May, June, 1948. Nat. Fur News, Denver, vol. 20, no. 5, pp. 10, 29, 31, 34. June, 1948. Amer. Fur Breeder, Duluth, vol. 21, no. 1, pp. 6, 8, 10. July, 1948.

CHADDOCK, T. T. Keeping your herd alive. Nat. Fur News, Denver, vol. 20, no. 8, pp. 12, 32. September, 1948. (Mink)

CHAIKOFF, I. L. T. GILLMAN, E. ENTENMAN, J. F. RINEHART, AND F. L. REICHERT. Cirrhosis and other hepatic lesions produced in dogs by thyroidectomy and by combined pancreatectomy and thyroidectomy. Jour. Exper. Med., Baltimore, vol. 88, no. 1, pp. 1–14, pls. 4. July 1, 1948.

CHANG, MIN-CHUEH. Transplantation of fertilized rabbit ova: the effect on viability of age, in vitro storage period, and storage temperature. Nature, London, vol. 161, no. 4103, pp. 978–979. June 19, 1948.

CLARKE, D. H., AND J. P. FOX. The phenomenon of intro hemolysis produced by the rickettsiae of typhus fever, with a note on the mechanism of rickettsiae toxicity in mice. Jour. Exper. Med., Baltimore, vol. 88, no. 1, pp. 25–41. July 1, 1948.

CLARKE, ROBERT. Hearing in Cetacea. Nature, London, vol. 161, no. 4103, pp. 979–980. June 19, 1948.

COCKRUM, E. LENDELL. The distribution of the hispid cotton rat in Kansas. Trans. Kansas Acad. Sci., Topeka, vol. 51, no. 3, pp. 306–312, figs. 3. 1948.

COLE, LAMONT C. Population phenomena and common knowledge. Sci. Monthly, Lancaster, vol. 67, no. 5, pp. 338–345, figs. 4. November, 1948.

COOKE, H. B. S. The search for man's ancestors. South African Sci., Johannesburg, vol. 2, no. 2, pp. 34–36. September, 1948.

CULBREATH, JACK C. Colorado elk on increase. Colorado Conserv. Comments, Denver, vol. 10, no. 6, pp. 7–8, 25. June, 1948.

CURLEY, F. J., AND J. E. GORDON. Immunization of mice with unmodified MM mouse encephalomyelitis virus and on passive protection from immune mothers. Amer. Jour. Hygiene, Lancaster, vol. 48, no. 1, pp. 81–86. July, 1948.

CURTIS, JAMES D. Animals that eat ponderosa pine seed. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 327–328. July, 1948.

DASMANN, WILLIAM P. A critical review of range survey methods and their application to deer range management. California Fish & Game, San Francisco, vol. 34, no. 4, pp. 189–207. October, 1948.

DASPIT, ARMAND P. Louisiana's fur industry. Louisiana Conservationist, New Orleans, vol. 1, no. 2, pp. 16–18, illus. October, 1948.

DAVENPORT, L. A. Farm-land deer. Michigan Conserv., Lansing, vol. 17, no. 11, pp. 11–12. November, 1948.

DAVENPORT, V. D., AND H. W. DAVENPORT. The relation between starvation, metabolic acidosis and convulsive seizures in rats. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 139–151. July 10, 1948.

DAVENPORT, V. D., AND H. W. DAVENPORT. Brain excitability in pyridoxine deficient rats. Jour. Nutrition, Philadelphia, vol. 36, no. 2, pp. 263–275. August 10, 1948.

DAVIS, D. E., AND OCTAVIA HALL. The seasonal reproductive condition of male brown rats in Baltimore, Maryland. Physiol. Zool., Chicago, vol. 21, no. 3, pp. 272–282. July, 1948.

DEDERER, MICHAE' What makes a mutation mink desirable. Black Fox Mag., New York, vol. 32, no. 4, pp. 11, 29. August, 1948.

DERANIYAGALA, P. E. P. Fossil hunting in Africa. Free Lanka Review, Ceylon, vol. 1 no. 2, pp. 2–4, figs. 3. June, 1948.

DIEKE, SALLY H. Pigmentation and hair growth in black rats, as modified by the chronic adminstration of thiourea, phenyl thiourea and alpha-naphthyl thiourea. Endocrinology, Boston, vol. 40, no. 3, pp. 123–136. March, 1947.

DIEKE, SALLY H. The effect of removing various endocrine glands on the hair cycles of black rats. Endocrinology, Boston, vol. 42, no. 4, pp. 315–319, fig. 1. April, 1948.

DIEKE, SALLY H., GEORGE S. ALLEN, AND CURT P. RICHTER. The acute toxicity of thioureas and related compounds to wild and domestic Norway rats. Jour. Pharmacol. & Exper. Therapeutics, vol. 90, no. 3, pp. 260–270. July, 1947.

DODSON, M. C. H. Physical nature of mouse brain. Nature, London, vol. 162, no. 4111, p. 253. August 14, 1948.

DOZIER, HERBERT L., AND MERTON RADWAY. Pelting muskrats by air inflation. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 333–334. July, 1948.

DURRANT, STEPHEN D., AND HAROLD S. CRANE. Three new beavers from Utah. Univ. Kansas Publ. Mus. Nat. Hist., Lawrence, vol. 1, no. 20, pp. 407–417, figs. 7. December 24, 1948. (New: *Castor canadensis pallidus; C. c. rostralis; C. c. duchesnei*)

DVOSKIN, SAMUEL. The effects of pituitary and non-pituitary gland factors on the formation of intracellular colloid droplets in the thyroid epithelium of hypophysectomized rats. Endocrinology, Boston, vol. 43, no. 1, pp. 52–70, pls. 2. July, 1948.

EARL, J. CURTIS. The journey of a Utah badger. Utah Fish & Game Bull., Salt Lake City, vol. 6, no. 2, p. 8. October, 1948. (Badger swimming)

EDGREN, RICHARD A., JR. Notes on a northern short-tailed shrew. Nat. Hist. Miscellanea, Chicago, no. 25, pp. 2. September 25, 1948.

ERICKSON, MILDRED J. Wild animal show. Amer. Forests, Washington, vol. 54, no. 8, pp. 356–358, illus. August, 1948.

ETHEREDGE, O. F., AND W. C. GLAZENER. The 1947 antelope hunt. Texas Game & Fish, Austin, vol. 6, no. 7, pp. 5, 17. June, 1948.

FABER, H. K., R. J. SILVERBERG, AND LUTHER DONG. Poliomyelitis in the cynomolgus monkey. Jour. Exper. Med., Baltimore, vol. 88, no. 1, pp. 65–72. July 1, 1948.

FABER, H. K., ROSALIE J. SILVERBERG, AND LUTHER DONG. Poliomyelitis in Philippine cynomolgus monkeys after simple feeding. Amer. Jour. Hygiene, Lancaster, vol. 48, no. 1, pp. 94–98. July, 1948.

FIELD, HENRY. The University of California African expedition: Part 1, Egypt. Amer. Anthropologist, Menasha, vol. 50, no. 3, pt. 1, pp. 479–493. July–September, 1948.

FINCKENSTEIN, KLAUS GRAF. Vom Anlauf, vom Saubock und vom Kujelhirsch. Wald und Wild, Hamburg, Jahrg. 1, nos. 3–4, pp. 8–9, figs. 3. October 15, 1948.

FISH, H. S., P. D. MALONE, AND CURT PAUL RICHTER. The anatomy of the tongue of the domestic Norway rat. 1. The skin of the tongue; the various papillae; their number and distribution. Anat. Record, Philadelphia, vol. 89, no. 4, pp. 429–440, figs. 6. August, 1944.

FISH, HAROLD S., AND CURT P. RICHTER. Comparative numbers of fungiform and foliate papillae on tongues of domestic and wild Norway rats. Proc. Soc. Exper. Biol. and Med., Utica, vol. 63, no. 2, pp. 352–355, fig. 1. November, 1946.

FLINT, RICHARD FOSTER. Beginning of the Pleistocene in eastern United States. Bull. Geol. Soc. America, Baltimore, vol. 59, no. 6, pp. 543–548. June, 1948.

FOLLEY, S. J., AND T. H. FRENCH. Respiratory quotient of the mammary gland. Science, Lancaster, n. s., vol. 161, no. 4102, pp. 933–934. June 12, 1948.

FOREMAN, HOWARD R. Treatment of boils in mink. Amer. Fur. Breeder, Duluth, vol. 21, no. 2, p. 30. July, 1948.

FOX, WADE. Variation in the deer-mouse (*Peromyscus maniculatus*) along the lower Columbia River. Amer. Midland Nat., Notre Dame, vol. 40, no. 2, pp. 420–452, figs. 2. September, 1948.

GALBREATH, EDWIN C. An additional specimen of the rodent Dikkomys from the Miocene of Nebraska. Trans. Kansas Acad. Sci., Topeka, vol. 51, no. 3, pp. 316–317, fig. 1. 1948.

GALBREATH, EDWIN C. A new species of heteromyid rodent from the Middle Oligocene of northeast Colorado with remarks on the skull. Univ. Kansas Publ. Mus. Nat. Hist., Lawrence, vol. 1, no. 18, pp. 285–300, pls. 2–3. August 16, 1948. (New: *Heliscomys tenuiceps*)

GALLARDO, E. F. PEREZ, AND J. P. FOX. Infection and immunization of laboratory animals with Rickettsia prowazekii of reduced pathogenicity, strain E. Amer. Jour. Hygiene, Lancaster, vol. 48, no. 1, pp. 6–21. July, 1948.

GIBSON-HILL, C. A. A further note on the bearded pig in Malaya. Jour. Bombay Nat. Hist. Soc., vol. 47, no. 4, pp. 632–637, 1 map. August, 1948.

GLAUERT, L. The genus Mesoplodon in Western Australian seas. Australian Zoologist, Sydney, vol. 11, no. 2, pp. 73–75, figs. 3. June 20, 1947.

GLAZENER, W. C. Homing instinct of white-tailed deer. Texas Game & Fish, Austin, vol. 6, no. 8, pp. 5, illus. July, 1948.

GOLLAN, JOSE SANTOS. La comadrejita enana *Dromiciops australis australis* (F. Philippi). Holmbergia, Buenos Aires, vol. 4, no. 9, pp. 191–195, pls. 3. October 28, 1946.

GOPALKRISHNA, A. Studies on the embryology of Microchiroptera. Pt. 1. Reproduction and breeding seasons in the South Indian vespertilionid bat—*Scotophilus wroughtoni* (Thomas). Proc. Indian Acad. Sci., Bangalore City, sect. B., vol. 26, no. 6, pp. 219–231, figs. 3. December, 1947.

GORMAN, RICHARD F. A new program for the chinchilla industry. Amer. Fur Breeder, Duluth, vol. 21, no. 1, pp. 48–54. July, 1948.

GOTHIER, FRANK C. How I developed a new strain of mink. Amer. Fur Breeder, Duluth, vol. 21, no. 1, pp. 18–28. July, 1948.

GOVAERTS, J., AND M. J. DALLEMAGNE. Influence of folliculin on bone metabolism, studied by means of radiophosphorus. Nature, London, vol. 161, no. 4103, p. 977. June 19, 1948.

GRAEF, RUDOLF A. What you should know about buying chinchillas. Black Fox Mag., New York, vol. 32, no. 2, pp. 17, 33. June, 1948.

GRANADOS, HUMBERTO, AND HENRIK DAM. Testicular hypoplasia and epididymal cysts in the Syrian hamster. Nature, London, vol. 162, no. 4112, p. 297. August 21, 1948.

GREEN, DORR D. Rats are robbers. Reclamation Era, Washington, vol. 34, no. 8, pp. 157–158, illus. August, 1948.

GREEN, MORTON. A new species of dog from the Lower Pliocene of California. Univ.

California Publ., Bull. Dept. Geol. Sci., Berkeley, vol. 28, no. 4, pp. 81–90, figs. 5. August 31, 1948. (New: *Tomarctus robustus*)

GRIFFITHS, WILLIAM J., JR. Audiogenic fits produced by magnesium deficiency in tame domestic Norway rats and in wild Norway and Alexandrine rats. Amer. Jour. Physiol., Baltimore, vol. 149, no. 1, pp. 135–141, figs. 3. April, 1947.

GRIMMER, W. F. Game management in Wisconsin. Wisconsin Conserv. Bull., Madison, vol. 13, no. 6, pp. 61–66, illus. June, 1948.

GUNN, C. K. A program of improved methods of selection and breeding is urgently needed in the Canadian fox ranching industry. Fur of Canada, Winnipeg, vol. 13, no. 10, pp. 24–25. July, 1948.

HAAG, WM. G. An osteometric analysis of some aboriginal dogs. Univ. Kentucky Reports Anthropol., Lexington, vol. 7, no. 3, pp. 105–264, figs. 16. December, 1948.

HADDOW, A. J., K. C. SMITHBURN, A. F. MAHAFFY, AND J. C. BUGHER. Monkeys in relation to yellow fever in Bwamba County, Uganda. Trans. Roy. Soc. Trop. Med. & Hygiene, London, vol. 40, no. 5, pp. 677–700, figs. 5, illus. May, 1947

HALE, HERBERT M. The pigmy sperm whale (Kogia breviceps, Blainville) on South Australian coasts. Records South Australian Mus., Adelaide, vol. 8, no. 4, pp. 531–546, figs. 16, pls. 14–18. December 10, 1947.

HALL, CHARLES E. Comparison of the preputial glands in the Alexandrine, the wild, and the domestic Norway rat. Proc. Soc. Exper. Biol. & Med., Utica, vol. 69, no. 2, pp. 233–237, figs 3. November, 1948.

HALL, E. RAYMOND. Two new meadow mice from Michoacan, Mexico. Univ. Kansas Publ. Mus. Nat. Hist., Lawrence, vol. 1, no. 21, pp. 423–427, figs. 6. December 24, 1948. (New: *Microtus mexicanus fundatus; M. m. salvus*)

HALL, W. K., L. L. BOWLES, V. P. SYDENSTRICKER, AND H. L. SCHMIDT, JR. Cataracts due to deficiencies of phenylalanine and of histidine in the rat. A comparison with other types of cataracts. Jour. Nutrition, Philadelphia, vol. 36, no. 2, pp. 277–291, pls. 2. August 10, 1948.

HAMILTON, J. E. Effect of present-day whaling on the stock of whales. Nature, London, vol. 161, no. 4102, pp. 913–914. June 12, 1948.

HAMMOND, GEO. H. Mass migration of bats, Clarenceville, P. Q., 1931. Canadian Field-Nat., Ottawa, vol. 62, no. 4, p. 124. July–August, 1948.

HANDLEY, C. O. Cottontail rabbit management. West Virginia Conservation, Charleston, vol. 12, no. 8, pp. 4, 19, illus. November, 1948.

HANSSON, ARTUR. The physiology of reproduction in mink (Mustela vison, Schreb.) with special reference to delayed implantation. Acta Zoologica, Stockholm, vol. 28, no. 1, pp. 1–136, figs. 77. 1947.

HARDY, THORA M. PLITT. Curl characteristics of Karakul pelts. Nat. Fur News, Denver, vol. 20, no. 6, pp. 13, 28–29, illus. July, 1948.

HARDY, THORA M. PLITT. Wolverine fur frosting. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 331–334. July, 1948.

HARKEMA, REINARD, AND LEO KARTMAN. Observations on the helminths and ectoparasites of the cotton rat, *Sigmodon hispidus hispidus*, Say and Ord, in Georgia and North Carolina. Jour. Elisha Mitchell Scientific Soc., Chapel Hill, vol. 64, no. 2, pp. 183–191, tbls. 5. December, 1948.

HARTMAN, CARL G. The mating of mammals. Ann. New York Acad. Sci., New York, vol. 46, art. 1, pp. 23–44. June 15, 1945.

HARTRIDGE, H. Recent advances in color vision. Science, Lancaster, vol. 108, no. 2807, pp. 395–404. October 15, 1948.

HAWLEY, HARRIET S. Our champion tree planter. Our Dumb Animals, Norwood, vol. 81, no. 6, p. 9, illus. June, 1948. (Squirrel)

HEIZER, ROBERT F. Artifact transport by migratory animals and other means. Amer. Antiquity, Menasha, vol. 9, no. 4, pp. 395–400, fig. 32. April, 1944.

HENDERSON, DAVID W. Genetic survey being made of Stewart mink. Black Fox Mag., New York, vol. 32, no. 2, p. 20. June, 1948.

HENSLEY, ARTHUR L., AND B. C. FOX. Experiments on the management of Colorado River beaver. California Fish & Game, San Francisco, vol. 34, no. 3, pp. 115–131, illus. July 1, 1948.

HEPTNER, W.G. Notes sur les Gerbillidae (Mammalia, Glires). XI. Sur les relations réciproques de certaines Gerbilles de l'Afrique du Nort et de l'Asie. Mammalia, Paris, vol. 10, no. 1, pp. 4–12, fig. 1. 1946.

HEWITT, REDGINAL, WYETH WHITE, E. WHITE, AND Y. SUBBAROW. The treatment of ascariasis in dogs with 1-diethylcarbamyl-4-methylpiperazine hydrochloride. Jour. Parasitol., Lancaster, vol. 34, no. 3, pp. 237–239. June, 1948.

HIBBARD, CLAUDE W. Late Cenozoic climatic conditions in the high plains of western Kansas. Bull. Geol. Soc. Amer., Baltimore, vol. 59, no. 6, pp. 592–597. June, 1948.

HILL, J. E., P. L. EWING, AND G. A. EMERSON. Effects of "benzedrine" sulfate on estrous cycles of rats. Texas Repts. Biol., Austin, vol. 6, no. 2, pp. 159–167. Summer, 1948.

HILL, RALPH R., AND JAS. W. KIMBALL. Uniformity of expression in game management. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 232–236. July, 1948.

HILL, W. C. OSMAN. Rhinoglyphics: Epithelial sculpture of the mammalian rhinarium. Proc. Zool. Soc. London, vol. 118, pt. 1, pp. 1–35, figs. 33. May 20, 1948.

HOFFMAN, F., E. J. HOFFMAN, AND J. TALESNIK. The influence of thyroxine and adrenal cortical extract on the oxygen consumption of adrenalectomized rats. Jour. Physiol., London, vol. 107, no. 3, pp. 251–264. June 25, 1948.

HOFFMEISTER, DONALD F., AND LEE G. GREBNER. A specimen of the white-tailed jack rabbit, *Lepus townsendii*, from Illinois. Nat. Hist. Miscellanea, Chicago, no. 29, pp. 1–2. October 15, 1948.

HOOPER, EMMET T., AND CHARLES O. HANDLEY, JR. Character gradients in the spiny pocket mouse, *Liomys irroratus*. Occas. Papers Mus. Zool. Univ. Michigan, Ann Arbor, no. 514, pp. 1–34. October 29, 1948.

HOUGH, JEAN RINGIER. The auditory region in some members of the Procyonidae, Canidae, and Ursidae. Its significance in the phylogeny of the Carnivora. Bull. Amer. Mus. Nat. Hist., New York, vol. 92, pp. 67–118, figs. 11, pls. 9–15. November 1, 1948.

HOVIND, JAMES. Beaver trouble. Wisconsin Conserv. Bull., Madison, vol. 13, no. 7, pp. 15–17, illus. July, 1948.

HOWE, H. A., AND DAVID BODIAN. Poliomyelitis in the cynomolgus monkey following oral inoculation. Amer. Jour. Hygiene, Lancaster, vol. 98, no. 1, pp. 99–106. July, 1948.

HUEBNER, ROBERT J., WILLIAM L. JELLISON, AND CHARLES POMERANTZ. Rickettsialpox—A newly recognized rickettsial disease. IV. Isolation of Rickettsia apparently identical with the causative agent of Rickettsialpox from *Allodermanyssus sanguineus*, a rodent mite. Public Health Reports, vol. 61, no. 47, pp. 1677–1682. November 22, 1946.

HUTT, F. B. Genetic purity in animal colonies. Ann. New York Acad. Sci., vol. 46, art. 1, pp. 5–21. June 15, 1945.

INGRAM, M. Norwegian whalemeat production. DSIR Food Investigation Memoir, London, no. 555, pp. 8, illus. (Not dated)

JACKSON, H. W. Wildlife underground. Virginia Wildlife, Richmond, vol. 9, no. 10, pp. 5–7, 26, illus. October, 1948. (Animals found in caves, including bats and rodents)

JACOB, P. K., AND M. D. MENON. The piscivorous habits of the rorqual or fin whale, (Balaenoptera sp.). Jour. Bombay Nat. Hist. Soc., vol. 47, no. 1, pp. 156–158. August, 1947.

JAEGER, ELLSWORTH. Tracks and trailcraft. Macmillan Co., New York, pp. 381, illus. 1948.

JAMESON, E. W., JR. Myobiid mites (Acarina: Myobiidae) from shrews (Mammalia: Soricidae) of Eastern North America. Jour. Parasitol., Lancaster, vol. 34, no. 4, pp. 336–342. August, 1948.

JELLISON, WILLIAM L. Siphonaptera host distribution of the genus Opisocrostis Jordan. Trans. Amer. Microscop. Soc., vol. 66, no. 1, pp. 64–69. January, 1947. (*Citellus*, *Cynomys*, and *Mustela* are hosts)

JELLISON, WILLIAM L. An undetermined parasite in the lungs of a rock rabbit, *Ochotona princeps* Richardson (Lagomorpha: Ochotonidae). Proc. Helminthol. Soc. Washington, vol. 14, no. 2, pp. 75–77, figs. 3. July, 1947.

JENKINS, HUBERT O. A population study of the meadow mice (*Microtus*) in three Sierra Nevada meadows. Proc. California Acad. Sci., San Francisco, ser. 4, vol. 26, no. 3, pp. 43–67, figs. 11, tables 3. June 28, 1948.

JENKINS, JAMES TRAVIS. Bibliography of whaling. Jour. Soc. Bibliog. Nat. Hist., London, vol. 2, pt. 4, pp. 71–166. November 3, 1948.

JOHNSON, R. M., AND C. A. BAUMANN. Relative significance of growth and metabolic rate upon the utilization of vitamin A by the rat. Jour. Nutrition, Philadelphia, vol. 35, no. 6, pp. 703–715. June 10, 1948.

JONAS, L. F. Mink and water. Nat. Fur News, Denver, vol. 20, no. 5, pp. 15, 26. June, 1948.

JUBB, ANNANELL C., RUTH NITCHALS, DENA C. CEDERQUIST, AND MARGARET A. OHLSON. Total and differential leucocyte values of blood from albino rats of the Wistar strain. Quart. Bull. Michigan Agr. Exp. Sta., East Lansing, vol. 31, no. 1, pp. 61–64. August, 1948.

KADE, C. F., JR., J. H. PHILLIPS, AND WM. A. PHILLIPS. The determination of the minimum nitrogen requirement of the adult dog for maintenance of nitrogen balance. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 109–121. July 10, 1948.

KING, JAMES E. Deer range experiments in the Black Hills. South Dakota Conservation Digest, Madison, vol. 15, no. 9, pp. 10, 14–15, illus. September, 1948.

KOHLS, GLEN M., AND WILLIAM L. JELLISON. Ectoparasites and other arthropods occurring in Texas bat caves. Bull. Nat. Speleol. Soc., no. 10, pp. 116–117. April, 1948.

KONZETT, H., AND E. B. VERNEY. Observations on the urine, blood and arterial pressure of dogs before and after the production of renal ischaemia. Jour. Physiol., London, vol. 107, no. 3, pp. 336–345. June 25, 1948.

LANE, H. H. Survey of the fossil vertebrates of Kansas. Trans. Kansas Acad. Sci., Topeka, vol. 51, pp. 29–76, figs. 15. March 31, 1948.

LAWRENCE, R. F. Some new pilicolous mites from South African mammals. Parasitology, London, vol. 39, nos. 1–2, pp. 39–42, illus. July, 1948.

LAWRENCE, W. E., AND R. E. REWELL. The cerebral blood supply in the Giraffidae. Proc. Zool. Soc. London, vol. 118, pt. 1, pp. 202–212, figs. 7. May 20, 1948.

LEAVITT, BENJAMIN. Is predator control effective? Florida Wildlife, Tallahassee, vol. 2, no. 6, pp. 6–7, illus. November, 1948.

LEEDY, DANIEL L. Further observations on the Ohio game kill and wildlife economics—1947. Ohio Conserv. Bull., Columbus, vol. 12, no. 8, pp. 4–5, 29. August, 1948.

LHOTE, H. Observations sur la répartition actuelle et les mœurs de quelques grands mammifères du pays Touareg. Mammalia, Paris, vol. 10, no. 1, pp. 26–56, figs. 7. 1946.

LITTLE, C. C. Genetics of cocker spaniels. Jour. Heredity, Baltimore, vol. 39, no. 6, pp. 181–185. June, 1948.

LOOSLI, J. K. Feeding laboratory animals. Ann. New York Acad. Sci., vol. 46, art. 1, pp. 45–75. June 15, 1945.

LORING, J. ALDEN. Our mountain beaver of the West. Nature Mag., Washington, vol. 41, no. 7, pp. 355–357, 386, illus. August–September, 1948.

LUNDMAN, BERTIL. Geography of human blood groups (A, B, O system). Evolution, Lancaster, vol. 2, no. 3, pp. 231–237, figs. 5. September, 1948.

MACKINTOSH, N. A. The stock of whales. Nature, London, vol. 162, no. 4108, p. 148. July 24, 1948.

MAKINO, SAJIRO. A study of the chromosomes in two species of bats (Chiroptera). Biol. Bull., Lancaster, vol. 94, no. 3, pp. 275–282. June, 1948.

MARSH, A. Marsh discusses quail-fox relationship. Tennessee Conservationist, Nashville, vol. 13, nos. 5–6, pp. 4–5. May–June, 1948.

MATHESON, COLIN. History of the lynx. Jour. Soc. Preservation Fauna Empire, n. s., pt. 58, pp. 18–27, pl. 1. December, 1948.

MATTHEWS, LEO HARRISON. A note on *Crocidura russula* and other mammals in Alderney, Channel Islands. Jour. Animal Ecology, Cambridge, England, vol. 16, no. 2, p. 225. November, 1947.

MATTHEWS, L. HARRISON, AND JAMES S. BAXTER. Polythelia in a chimpanzee. Proc. Zool. Soc. London, vol. 118, pt. 1, pp. 144–145. May 20, 1948.

MCCOWAN, DAN. Hunting with a camera. Beaver, Winnipeg, outfit 279, pp. 22–25, illus. June, 1948.

MCGREW, PAUL O. The Blancan faunas, their age and correlation. Bull. Geol. Soc. Amer., Baltimore, vol. 59, no. 6, pp. 549–552, fig. 1. June, 1948.

MCINTYRE, ROBERT N. A new park resident. Yosemite Nature Notes, vol. 27, no. 4, pp. 69–74, illus. April, 1948. (Beaver)

MCKEAN, WM. T. Winter and the deer herd. North Dakota Outdoors, Bismarck, vol. 10, no. 12, pp. 5–6, illus. June, 1948.

MCKELVEY, NAT. W., AND HELEN HARGREAVES. Royale vacation. American Forests, Washington, vol. 54, no. 7, pp. 306–309, illus. July, 1948. (Moose on Isle Royal)

MELNICK, J. L., AND HERDIS VON MAGNUS. Comparative susceptibility of cynomolgus and other monkey species to poliomyelitis virus by the intracerebral and oral routes. Amer. Jour. Hygiene, Lancaster, vol. 48, no. 1, pp. 107–112. July, 1948.

MENARD, HENRY W., JR. Analysis of measurements in length of the metapodials of Smilodon. Bull. Southern California Acad. Sci., Los Angeles, vol. 46, no. 3, pp. 127–135, pls. 5. April 20, 1948.

MÉRY, F. Le botulisme chez le chien. Bull. Acad. Vétérinaire France, Paris, vol. 20, no. 1, pp. 28–37. January, 1947.

MEZGER, HERBERT. Fur for profit. Black Fox Mag., New York, vol. 32, no. 4, pp. 13, 32–33, 34–35. August, 1948. See also Nat. Fur News, Denver, vol. 20, no. 8, pp. 15, 24–26. September, 1948.

MILLS, CLARENCE A. Influence of environmental temperatures on warm-blooded animals. Ann. New York Acad. Sci., vol. 46, art. 1, pp. 97–113. June 15, 1945.

MINETT, F. C. Notes on flying squirrel (Petaurista sp.). Jour. Bombay Nat. Hist. Soc., vol. 47, no. 1, pp. 52–56, figs. 2. August, 1947.

MOCK, JOHNNY. Pennsylvania's attempts to stock elk prove a flop. Outdoor Life, New York, vol. 101, no. 6, pp. 124–125. June, 1948.

MOHR, ERNA. Die Jugendfärbung der Brandmaus und die Aalstrich-Frage. Zool. Anzeiger, Leipzig, vol. 128, nos. 9–10, pp. 250–254, figs. 3. December 15, 1939.

MOHR, ERNA. Solenodon, der "Rinnenzahn." Zool. Anzeiger, Leipzig, vol. 126, nos. 3–4, pp. 94–95, fig. 1. May 1, 1939.

MOHR, ERNA. Akromelanismus bei Mus musculus L. Zool. Anzeiger, Leipzig, vol. 126, nos. 1–2, pp. 45–46. April 15, 1939.

MOHR, ERNA. Einiges über Eselfärbung. Zool. Garten, Leipzig, N.F., vol. 12, nos. 4–6, pp. 299–306, figs. 15. December, 1940.

MOHR, ERNA. Der Pyrenäenhund. Rundschau für Jagd und Hundesport, Plauen, pp. 94–96, figs. 4. September, 1940.

MOHR, ERNA. Bruno Liljefors. [Obituary.] Zool. Garten, Leipzig, N.F., vol. 12, no. 1, pp. 58–60, figs. 2. March, 1940.

MOHR, ERNA. Die Säugetiere im Fürstlich Schönburgischen Naturalienka-binett und Lincks Beziehungen zur Säugetierkunde. Mitteil. des Fürstlich Schönburg-Waldenburgschen Familienvereins Schloss Waldenburg, no. 9, pp. 1–45, figs. 17. 1941.

MOHR, ERNA. Schwanzverlust und Schwanzregeneration bei Nagetieren. Zool. Anzeiger, Leipzig, vol. 135, nos. 3–4, pp. 49–65, figs. 14. August 1, 1941.

MOHR, ERNA. Säugetiertypen im Zoologischen Museum Halle a.S. Zeitschr. Naturwissenschaften, Halle a.S., vol. 94, pp. 215–226. 1941.

MOHR, ERNA. Cryptoprocta ferox Benn. im ehemaligen Hamburger Zoo. Zool. Garten, Leipzig, N.F., vol. 14, no. 4, pp. 210–211, fig. 1. 1942.

MOHR, ERNA. Einiges über die Saiga, Saiga tatarica L. Zool. Garten, Leipzig, N.F., vol. 15, nos. 5–6, pp. 175–185, figs. 12. 1943.

MOHR, ERNA. Noch eine alte Wisent-Darstellung von Roelant Savary. Berichte Internat. Ges. Erhaltung Wisents, vol. 3, no. 5, pp. 312–313, pls. 31. December 20, 1943.

MOHR, ERNA. Die ehemalige Hamburger Zucht des Schomburgk-Hirsches, Rucervus schomburgki Blyth. Zool. Anzeiger, Leipzig, vol. 142, nos. 1–2, pp. 30–35, figs. 4. April 15, 1943.

MOHR, ERNA. Alterstod und Zahnverhältnisse beim Schlitzrüssler, Solenodon paradoxus Brandt. Zool. Anzeiger, Leipzig, vol. 141, nos. 11–12, pp. 264–268, fig. 1. March 31, 1943.

MOHR, ERNA. Ziesel von dreierlei Art. Mitteil. Zool. Garten, Leipzig, N.F., 1944/45, no. 6, pp. 14–18, figs. 3. 1945. (*Citellus*)

MOHR, ERNA. Aussterbende Wildarten in Mitteleuropa: Der Wisent. Wild und Hund, Hamburg, Jahrg. 51, no. 7, pp. 152–155, figs. 4. November, 1948.

MOHR, ERNA. Geschichte und Stand der schwedischen Wisentzuchten. Wald und Wild, Hamburg, Jahrg. 1, nos. 3–4, pp. 10–13, figs. 11. October 15, 1948.

MOMB, A. K. Report on removal of nuisance beaver July 1, 1947 to June 30, 1948. North Dakota Outdoors, Bismarck, vol. 11, no. 2, p. 12, illus. August, 1948.

MOORE, CARL R., AND DOROTHY PRICE. A study at high altitude of reproduction, growth, sexual maturity, and organ weights. Jour. Exper. Zool., Philadelphia, vol. 108, no. 2, pp. 171–216. July, 1948.

MOORE, PHIL H. Gatos y perros. Caza Tiro y Pesca, Mexico, vol. 18, nos. 184–187, pp. 20–24, illus. August, 1948.

MORRIS, J. ANTHONY, AND E. R. QUORTRUP. Klebsiella ozaenae infection in ranch raised minks. Amer. Nat. Fur & Market Jour., Wausau, vol. 26, no 12, pp. 20, 24. July, 1948.

MOULDER, J. W. Changes in the glucose metabolism of Trypanosoma lewisi during the course of infection in the rat. Jour. Infectious Diseases, Chicago, vol. 83, no. 1, pp. 42–49. July–August, 1948.

MÜLLER, H. C. Gedanken um unser Rotwild. Wald und Wild, Hamburg, Jahrg. 1, nos. 3–4, pp. 3–4, figs. 3. October 15, 1948.

NAYLOR, G. R. E. Some observations on the reaction between horse serum and a pool of rabbit antihorse serum. I. The relative inhibitory effect of excess antigen and excess antiserum. Jour. Hygiene, London, vol. 46, no. 2, pp. 129–135. July, 1948.

NELSON, JOHN B. The nasal transmission of pleuropneumonia-like organisms in mice and rats. Jour. Infectious Diseases, Chicago, vol. 82, no. 2, pp. 169–176. March–April, 1948.

NESS, D. E. Nuisance beaver. Sylva, Toronto, vol. 4, no. 3, pp. 10–14, illus. 1948.

NOBLE, R. L., AND M. JEAN MILLAR. Some unusual findings on the carcinogenic action of urethane in mice. Nature, London, vol. 162, no. 4111, pp. 253–254. August 14, 1948.

NOTINI, G. Grävlingen oct viltvården. Svensk Jakt, Stockholm, vol. 86, no. 6, pp. 137–143, illus. June 15, 1948.

OBEE, D. J. Mammals of Rocky Mountain National Park and the Colorado Rockies. Published by the author, Colorado Springs, 29 pp., illus. 1945. (Popular accounts of 25 species)

O'CONNOR, W. JOSEPH. Rocky Mountain goats for Oregon mountain. Western Outdoors, Oswego, vol. 5, no. 7, p. 14. July, 1948.

ORCUTT, EDALEE. Puma, cougar, panther? San Diego Zoonooz, vol. 21, no. 8, pp. 5–7, illus. September, 1948.

PARRIS, HARRY S. Koalas on the lower Goulburn. Victorian Nat., Melbourne, vol. 64, no. 10, pp. 192–193. February, 1948.

PATTON, HARRY D. Secretory innervation of the cat's footpad. Jour. Neurophysiol., Springfield, vol. 11, pp. 217–228, figs. 6. 1948.

PEACOCK, P. R., AND S. BECK. Induced adenocarcinoma of the stomach in mice. Nature, London, vol. 162, no. 4111, pp. 252–253. August 14, 1948.

PEARSON, OLIVER P. Metabolism of small mammals, with remarks on the lower limit of mammalian size. Science, Lancaster, vol. 108, no. 2793, p. 44, fig. 1. July 9, 1948.

PEARY, J. Y. Survival of the European bison. Jour. Tennessee Acad. Sci., vol. 23, no. 2, pp. 169–172. April, 1948.

PHILLIPS, WENDELL. Recent discoveries in the Egyptian Faiyum and Sinai. Science, Lancaster, n. s., vol. 107, no. 2791, pp. 666–670. June 25, 1948.

PICKWELL, GAYLE. Golden-mantled marmot, western woodchuck. Nature Mag., Washington, vol. 41, no. 6, pp. 301–302. June–July, 1948.

POCOCK, R. I. The larger deer of British India. Part IV. The chital (*Axis*) and the hog-deer (Hyelaphus). Jour. Bombay Nat. Hist. Soc., vol. 44, no. 2, pp. 169–178, figs. 4–8. December, 1943.

POOLE, EARL L. A new race of the red-backed mouse (*Clethrionomys*) from Pennsylvania. Notulae Naturae Acad. Nat. Sci. Philadelphia, no. 212, p. 3. January 21, 1949. (New: *Clethrionomys gapperi rupicola*)

PORTER, K. R., AND H. P. THOMPSON. A particulate body associated with ephithelial cells cultured from mammary carcinomas of mice of a milk-factor strain. Jour. Exper. Med., Baltimore, vol. 88, no. 1, pp. 15–24, pls. 5–7. July 1, 1948.

POTTER, EDITH L. Fundamentals of human reproduction. McGraw-Hill, New York, pp. xi + 231, illus. 1948.

PRADA, JOAQUIN DE. El lobo y sus daños. Montes, Madrid, vol. 3, no. 17, pp. 458–462, figs. 4, maps 2. September–October, 1947.

QUIMBY, FREEMAN H. Food and water economy of the young rat during chronic starvation and recovery. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 177–186. July 10, 1948.

RALEIGH, GORDON W., AND GUY P. YOUMANS. The use of mice in experimental chemotherapy of Tuberculosis. I., II., III. Jour. Infectious Diseases, Chicago, vol. 82, no. 3, pp. 197–225. May–June, 1948.

RAND, A. L. Mammals of the eastern Rockies and western plains of Canada. Bull. Nat. Mus. Canada, Ottawa, no. 108, pp. 237, figs. 88. 1948.

REID, J. T., G. M. WARD, AND R. L. SALSBURY. Mineral metabolism studies in dairy cattle. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 75–89. July 10, 1948.

RENDTORFF, R. C. Investigations on the life cycle of *Oochoristica ratti*, a cestode from rats and mice. Jour. Parasitol., Lancaster, vol. 34, no. 3, pp. 243–251. June, 1948.

RICHARDSON, L. R. Density of the blackfish petrosal. Nature, London, vol. 162, no. 4108, p. 150. July 24, 1948.

RICHMOND, NEIL D. The Pennsylvania mammal survey. Pennsylvania Game News, Harrisburg, vol. 19, no. 6, pp. 7, 26, 30, 32, illus. September, 1948.

RICHTER, CURT P. Incidence of rat bites and rat bite fever in Baltimore. Jour. Amer. Med. Assoc., Chicago, vol. 128, pp. 324–326. June 2, 1945.

RICHTER, CURT P. Nutritive value of fructose for rats and effects produced on its utilization by thiamine. Amer. Jour. Physiol., Baltimore, vol. 154, no. 3, pp. 499–505, figs. 4. September, 1948.

RICHTER, CURT P., AND JOHN T. EMLEN, JR. A modified rabbit box trap for use in catching live wild rats for laboratory and field studies. U. S. Public Health Repts., Washington, vol. 60, no. 44, pp. 1303–1308, figs. 3. November 2, 1945.

RICHTER, CURT P., AND CHARLES E. HALL. Comparison of intestinal lengths and Peyer's patches in wild and domestic Norway and wild Alexandrine rats. Proc. Soc. Exper. Biol. & Med., Utica, vol. 66, pp. 561–566, figs. 4. 1948.

RITCHIE, J. W. The ranching of marten. Amer. Fur Breeder, Duluth, vol. 21, no. 1, pp. 36–42. July, 1948.

ROBINETTE, W. LESLIE. Deer mortality from gunshot wounds. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Leaflet 295, pp. 8. July, 1947.

ROBINSON, WELDON B. Thallium and compound 1080 impregnated stations in coyote control. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 279–295. July, 1948.

ROGERS, PHILIP V., AND CURT P. RICHTER. Anatomical comparison between the adrenal glands of wild Norway, wild Alexandrine and domestic Norway rats. Endocrinology, Los Angeles, vol. 42, no. 1, pp. 46–55, figs. 3. January, 1948.

ROSEN, B. VON. Oryx och hyenor. Svensk Jakt, Stockholm, vol. 86, no. 7, pp. 160–162, illus. July 15, 1948.

ROUX, G. H. The cranial development of certain Ethiopian "insectivores" and its bearing on the mutual affinities of the group. Acta Zoologica, Stockholm, vol. 28, nos. 2–3, pp. 165–397, figs. 69. 1947.

RUSSELL, LORIS S. Post-glacial occurrence of Mastodon remains in southwestern Ontario. Trans. Royal Canadian Inst., Toronto, vol. 27, no. 57, pp. 57–64, figs. 4. 1948.

RUSSELL, LORIS S. A middle Paleocene mammal tooth from the foothills of Alberta. Amer. Jour. Sci., New Haven, vol. 246, pp. 152–156, pl. 1. March, 1948. (*Pantolambda*)

RUUD, JOHAN T. Sperm oil. A short survey of sperm oil and its applications. Norsk Hvalfangst-Tidende (Norwegian Whaling Gazette), Sandefjord, vol. 37, no. 11, pp. 451–456. November, 1948.

SALCEDO, JUAN, JR., V. A. NAJJAR, L. E. HOLT, JR., AND E. W. HUTZLER. The relation between urinary excretion and tissue concentrations of thiamine in rats. Jour. Nutrition, Philadelphia, vol. 36, no. 2, pp. 307–313. August 10, 1948.

SAMUELS, LEO T. The relation of ascorbic acid metabolism in the rat to diets high in protein, carbohydrate or fat. Jour. Nutrition, Philadelphia, vol. 36, no. 2, pp. 205–213. August 10, 1948.

SCHAEFFER, BOBB. The origin of a mammalian ordinal character. Evolution, Lancaster, vol. 2, no. 2, pp. 164–175, figs. 5. June, 1948. (Tarsal elements in Artiodactyla)

SCHAUB, S. Die Vorderxtremität von Ancylotherium pentelicum Gaudry und Lartet. Abhandl. Schweizerischen Palaeontol. Gesell., vol. 64, no. 2, pp. 1–36, figs. 27, pls. 2. 1943.

SCHEFFER, VICTOR B. Use of fur-seal carcasses by natives of the Pribilof Islands, Alaska. Pacific Northwest Quarterly, Seattle, vol. 39, no. 2, pp. 131–132, fig. 1. April, 1948.

SCHNEIDER, KARL MAX. Der Schweinshirsch. Mitteil. Zool. Garten, Leipzig, N.F., 1944/45, no. 6, pp. 1–7, figs. 6. 1945.

SCHOENFELD, CLAY. Too many deer? Field & Stream, New York, vol. 53, no. 3, pp. 32–33, 114–116, illus. July, 1948.

SCHOOF, N. F. Common ectoparasites of the Norway rat, *Rattus norvegicus* (Erxl.), in North Carolina and the effects of 10 per cent DDT dust treatments in their

control and upon the serology of the rat. Jour. Elisha Mitchell Scientific Soc., Chapel Hill, vol. 64, no. 2, pp. 208–215. December, 1948.

SCHORGER, A. W. Changing wildlife conditions in Wisconsin. Wisconsin Conserv. Bull., Madison, vol. 13, no. 6, pp. 53–60, illus. June, 1948.

SCHULTZ, C. BERTRAND, AND W. D. FRANKFORTER. Preliminary report on the Lime Creek sites: New evidence of early man in southwestern Nebraska. Bull. Univ. Nebraska State Mus., Lincoln, vol. 3, no. 4, pt. 2, pp. 43–62, figs. 13. November, 1948.

SCHULTZ, C. BERTRAND, AND THOMPSON M. STOUT. Pleistocene mammals and terraces in the Great Plains. Bull. Geol. Soc. Amer., Baltimore, vol. 59, no. 6, pp. 553–588, figs. 4, pl. 1. June, 1948.

SCHWARZ, ERNST. Revision of the Old-World moles of the genus *Talpa* Linnaeus. Proc. Zool. Soc. London, vol. 118, pt. 1, pp. 36–48. May 20, 1948.

SCOTT, W. E. The public's part in Wisconsin conservation history. Wisconsin Conserv. Bull., Madison, vol. 13, no. 6, pp. 84–90. June, 1948.

SCOTT, WALTER E. Methods of controlled public hunting in the United States and Canada. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 236–240. July, 1948.

SCOTT, WALTER E. Controlled hunting. Texas Game & Fish, Austin, vol. 6, no. 10, pp. 4, 21. September, 1948.

SECKER, J. The influence of ovarian hormones on the transmission of the activity of the sympathetic nerves of the cat. Jour. Physiol., London, vol. 107, no. 3, pp. 265–271. June 25, 1948.

SHACKELFORD, RICHARD M. Discussion on mink mutation matings. Amer. Nat. Fur & Market Jour., Wausau, vol. 26, no. 12, p. 5. July, 1948.

SHAPTON, WARREN W. Grand Traverse region's deer problem. Michigan Conserv., Lansing, vol. 17, no. 11, pp. 4, 12, figs. 2. November, 1948.

SHAW, ROBERT W. Wildlife and the forests. Wildlife in North Carolina, Raleigh, vol. 12, no. 6, pp. 8–10, illus. October, 1948.

SHOEMAKER, HENRY E. Chester County—a hundred years ago. Pennsylvania Game News, Harrisburg, vol. 19, no. 3, p. 4, illus. June, 1948.

SHOEMAKER, HENRY W. The Pennsylvania bison. Pennsylvania Game News, Harrisburg, vol. 19, no. 4, p. 4, illus. July, 1948.

SILVA, JOÃO AUGUSTO. Animais selvagens. Contribuição para o estudo da fauna cinegética de Moçambique. O elande. Moçambique, Documentário Trimestral, Lourenço Marques, vol. 49, pp. 17–30, pls. 3. March, 1947.

SILVA, JOÃO AUGUSTO. Animais selvagens. Contribuição para o estudo da fauna cinegética de Moçambique. O egocero negro. Moçambique, Documentário Trimestral, Lourenço Marques, vol. 50, pp. 21–27, pl. 1. April–June, 1947. (Sable Antelope)

SIMON, JAMES R., AND ROBERT C. BROWN. Castors and castoreum. Wyoming Wild Life, Cheyenne, vol. 12, no. 6, pp. 14–16, illus. June, 1948.

SKINSNES, O. K., AND R. L. WOOLRIDGE. The relationship of biological defense mechanisms to the antibiotic activity of penicillin. I. The modifying influence of penicillin on the pattern of pneumococcic infection and the immune response in the protein-depleted rat. Jour. Infectious Diseases, Chicago, vol. 83, no. 1, pp. 77–86. July–August, 1948.

SMITH, MURRAY T. Last of the mammoths. Field & Stream, New York, vol. 53, no. 2, pp. 58–59, 152–155, illus. June, 1948. (Hunting African Elephants)

SNYDER, BILL. North Florida's war on foxes. Florida Wildlife, Tallahassee, vol. 2, no. 1, pp. 8–9, illus. June, 1948.

SODY, H. J. V. On a collection of rats from the Indo-Malayan and Indo-Australian regions. Treubia, Buitenzorg, vol. 18, pt. 2, pp. 255–325. December, 1941. (New: *Christomys, Frateromys, Arcuomys, Madromys, Taeromys, Mollicomys, Cironomys, Pullomys, Geromys, Millardomys, Octopodomys, Octomys, Papagomys; Rattus rattus aurorens, R. r. makassarius, R. r. pelengensis, R. r. obiensis, R. r. saturnus,*

R. r. chaseni, R. r. sebesianus, R. r. larusius, R. r. delirius, R. r. generatius, R. r. argyraceus, R. r. talaudensis, R. r. barussanoides, R. concolor malengiensis, R. c. meringgit, R. mulleri waringensis, R. rapit atchinensis, R. whiteheadi coritzae, R. hellwardi griseogenus, R. musschenbroekii lalawora, R. sapoensis, R. biformatus, R. elaphinus, R. foramineus, R. f. pelurus, R. toxi, R. rintjanus, Taeromys dominator ursinus, T. paraxanthus, T. tatei)

Sody, H. J. V. A new race of *Sus verrucosus* from Madoera Island. Treubia, Buitenzorg, vol. 18, pt. 2, pp. 393–394. December, 1941. (New: *Sus verrucosus olivieri*)

Sognnaes, R. F. Experimental rat caries. Jour. Nutrition, Philadelphia, vol. 36, no. 1, pp. 1–13. July 10, 1948.

Speck, Frank G. Utilization of marine life by the Wampanoag Indians of Massachusetts. Jour. Washington Acad. Sci., vol. 38, no. 8, pp. 257–265, figs. 3. August 15, 1948.

Spencer, Nels. Breeding mink to obtain size. Nat. Fur News, Denver, vol. 20, no. 7, pp. 26–27. August, 1948.

Stephenson, Ronald. Some problems in ranch management. Nat. Fur News, Denver, vol. 20, no. 6, pp. 12, 26–27. July, 1948.

Stock, Chester. A peculiar new carnivore from the Cuyama Miocene, California. Bull. Southern California Acad. Sci., Los Angeles, vol. 46, no. 2, pp. 84–89, pl. 1. February 5, 1948. (New: *Actiocyon leardi*)

Storer, Tracy I., and M. Mann. Bibliography of rodent control (first supplement) and bibliography of Antu. Div. Research Grants and Fellowships, Nat. Inst. Health, Washington, Rept. no. 1, pp. 76. 1948.

Stott, Ken, Jr. Hart Mountain. San Diego Zoonooz, vol. 21, no. 6, pp. 6–7. June, 1948. (Antelope)

Stott, Ken, Jr. Moose notes. San Diego Zoonooz, vol. 21, no. 7, pp. 3–4, illus. July, 1948.

Straus, William L., Jr. The humerus of Paranthropus robustus. Amer. Jour. Phys. Anthropol., Philadelphia, n.s., vol. 6, no. 3, pp. 285–312, figs. 25. September, 1948.

Struwing, Nels J. North Dakota fur harvest report—1947–48. North Dakota Outdoors, Bismarck, vol. 11, no. 2, p. 11. August, 1948.

Stuart, Russell W. The annual big game survey—winter 1948. North Dakota Outdoors, Bismarck, vol. 10, no. 12, pp. 12–13. June, 1948.

Stuewer, Frederick W. Artificial dens for raccoons. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 296–301, pl. 8. July, 1948.

Stunkard, Horace W. Pseudophyllidean cestodes from Alaskan pinnipeds. Jour. Parasitol., Lancaster, vol. 34, no. 3, pp. 211–228. June, 1948.

Sumner, Lowell. An air census of Dall sheep in Mount McKinley National Park. Jour. Wildlife Management, Menasha, vol. 12, no. 3, pp. 302–304, pl. 9. July, 1948.

Tate, G. H. H. Results of the Archbold Expeditions. No. 59. Studies on the anatomy and phylogeny of the Macropodidae (Marsupialia). Bull. Amer. Mus. Nat. Hist., New York, vol. 91, art. 2, pp. 233–352, figs. 3. November 1, 1948.

Taylor, Walter P. Outlines for the study of mammalian ecology and life histories. U. S. Dept. Interior, Fish and Wildlife Service, Wildlife Leaflet 304, pp. 26, illus. 1948.

Thwaites, Walter G. Nutria pelts and pelting. Nat. Fur News, Denver,vol. 20, no. 7, pp. 18–19, 28–31, illus. August, 1948.

Tiner, Jack D. *Syphacia eutamii* n. sp. from the least chipmunk, *Eutamias minimus*, with a key to the genus (Nematoda: Oxyuridae). Jour. Parasitol., Lancaster, vol. 34, no. 2, pp. 87–92. April, 1948.

Tiner, Jack D. Rictularia dipodomis n. sp. (Nematoda: Thelaziidae) from the kangaroo rat Dipodomys sp. Jour. Parasitol., Lancaster, vol. 34, no. 4, pp. 332–335. August, 1948.

Tiner, Jack D., and Ta Hsiung Chin. The occurrence of *Ascaris lumbricoides* L. 1758 in

the muskrat, *Ondatra zibethica* L. Jour. Parasitol., Lancaster, vol. 34, no. 3, p. 253. June, 1948.

ULMER, FREDERICK A., JR. Do bears hibernate? Frontiers, Lancaster, vol. 12, no. 5, pp. 131–134, illus. June, 1948.

URBAIN, ACH., AND J. NOUVEL. Tuberculose cutanée du cerf axis [*Axis axis* (Erxleb)] et du tigre (*Felis tigris* L.). Bull. Acad. Vétérinaire France, Paris, vol. 20, no. 1, pp. 38–40. January, 1947.

VALLEY, OLIVER J. Coon and "coonin". Wisconsin Conservation, Madison, vol. 13, no. 9, pp. 15–18, illus. September, 1948.

VANTIEL, N. The toxicity of methallyl chloride and methyl bromide towards white rats. Jour. Hygiene, London, vol. 46, no. 2, pp. 217–221. July, 1948.

VILLALTA COMELLA, JOSÉ F. DE, AND MIGUEL CRUSAFONT PAIRÓ. *Enhydriodon lluecai nova sp.* el primer lútrido del Pontiense español. Bol. Real Soc. Española Hist. Nat., Madrid, vol. 43, nos. 7–8, pp. 383–396, figs. 3. March 15, 1946. (New: *Enhydriodon lluecai*)

WADE, OTIS. Rapid fat production by ground squirrels preceding hibernation. Nat. Hist. Miscellanea, Chicago Acad. Sci., no. 28, pp. 1–3. October 12, 1948.

WALLACE, GEORGE J. The barn owl in Michigan—its distribution, natural history and food habits. Tech. Bull. Michigan Agric. Exp. Sta., East Lansing, no. 208, pp. 61. August, 1948. (99 per cent of food is small mammals)

WARD, L. W. Decline in deer mortalities. West Virginia Conservation, Charleston, vol. 12, no. 7, pp. 9–10. October, 1948.

WEBB-PEPLOE, C. G. Field notes on the mammals of South Tinnevelly, South India. Jour. Bombay Nat. Hist. Soc., vol. 46, no. 4, pp. 629–644, pl. 1. April, 1947.

WEINSTEIN, PAUL P., AND HARRY D. PRATT. The laboratory infection of Triatoma neotomae neiva with Trypanosoma cruzi chagas and subsequent transmission to white mice. Jour. Parasitol., Lancaster, vol. 34, no. 3, pp. 231–236. June, 1948.

WENTWORTH, EDWARD NORRIS. America's sheep trails; history, personalities. Iowa State College Press, Ames, pp. 667, illus. 1948.

WETTSTEIN, OTTO V. Die Säugerwelt der Ägäis, nebst einer Revision des Rassenkreises von Erinaceus europaeus. Ann. Naturhist. Mus. Wien, vol. 52, pp. 245–278, figs. 7, pls. 2. May, 1942.

WHITLOCK, S. C. Identification of wolf, coyote, dog simplified. Michigan Conserv., Lansing, vol. 17, no. 10, pp. 6–7, 15, illus. October, 1948.

WILCOMB, MAX J. The fox-pheasant problem. Oregon State Game Comm. Bull., Portland, vol. 3, no. 11, pp. 1, 6–7, illus. November, 1948.

WILKE, FORD, AND CHAS. F. BASSETT. The value of fat in the diet of growing mink. Amer. Nat. Fur & Market Jour., Wausau, vol. 27, no. 2, p. 11. September, 1948.

WILSON, L. WAYNE. An introduction to the mammals of West Virginia. Div. Education & Publicity, West Virginia Conserv. Comm., Charleston, pp. ii + 20. December, 1948.

WIMSATT, WM. A., AND F. T. LEWIS. Duplication of the mitral valve and a rare interventricular foramen in the heart of a yak calf. Amer. Jour. Anat., Philadelphia, vol. 83, no. 1, pp. 67–106, pl. 1. July, 1948.

WISLOCKI, GEO. B., AND EDWARD W. DEMPSEY. The chemical cytology of the chorioid plexus and blood brain barrier of the rhesus monkey (Macaca mulatta). Jour. Comp. Neurol., Philadelphia, vol. 88, no. 3, pp. 319–345, pls. 1–3, June, 1948.

WOLF, BILL. Minus compass or radar. Sports Afield, Minneapolis, vol. 119, no. 6, pp. 50–51, 104–107, illus. June, 1948. (Gray Squirrel migration)

ZLOTNIK, I. A comparative study of the cytoplasmic components during the oogenesis of dog, cat, and rabbit. Proc. Roy. Soc. Edinburgh, London, vol. 63, pt. 2, no. 13, pp. 200–212, pls. 3, figs. 4. December 18, 1948.

OBITUARY NOTICES

WILLIAM THOMAS SHAW: 1873–1948

William Thomas Shaw, Professor of Zoology Emeritus at Fresno State College, died at Fresno, California, May 13, 1948, bringing to an end the long and interesting career of one of our country's outstanding naturalists.

After retirement from active teaching in 1946, we were able to provide working quarters where Dr. Shaw could continue his research activities and writing. It became his routine to go to his room for a rest during the middle of the day. He was there at the time of his death.

Dr. Shaw enjoyed being with people and took considerable pride, and justly, in his many acquaintances and contacts with men famous in various fields. He enjoyed his students and followed with great interest the careers of many of them. He enjoyed conversation with his many friends, but in attempting to write a few notes regarding Dr. Shaw, we are suddenly aware that conversations seldom included anything personal.

Dr. Shaw earned degrees at Minnesota, B.Agr. '98, B.S. '99; Michigan, M.S. 1900, and Stanford, Ph.D. '26. His teaching experiences were varied as to subjects and schools. He taught at Michigan State College, Iowa State College, Oregon State College, Washington State College, lectured at Stanford University, taught at Redlands University and Fresno State College. To explain his frequent changes in schools he used to remark, rather shyly, that he was known as the tramp professor. He took great pride in a record of never missing any of his classes, due to sickness or otherwise.

Always with the students in mind, Dr. Shaw was interested in some sort of organization, such as a biology club, in which students could participate. At Fresno State College the Fresno Natural History Society was one of his main interests, and he served several terms as president and program director.

Having worked as a taxidermist to aid his way through college, this type of work was carried over into his teaching interests. A course called taxidermy and taught by Dr. Shaw was more than just setting a bird on a perch. Students learned first of all to collect specimens properly, and only the necessary specimens. Proper preparation of museum study skins, with all the field notes and data to go with them, was a rigid requirement. Mounting birds and mammals required a knowledge of the animals that would lead to the execution of a life-like pose. Thus, his course in taxidermy was not only a training in scientific collecting and skin preparation, but also involved considerable knowledge of natural history and ecology.

I believe every school where Dr. Shaw taught has some of the fine results of his scientific collecting and taxidermy. Outstanding in this regard is the series of habitat groups at Fresno State College. Sixteen groups represent a cross section, east and west, of the State of California. Over 150 mammals and birds, mounted by Dr. Shaw, are represented in natural habitats and in proper life zones. (See Scientific Monthly, 1945, Vol. LX, pp. 97–107).

Plans are now under way to dedicate these habitat groups, with a proper plaque, to the memory of Dr. Shaw. However, what more lasting memorial can one have than to leave his name in the literature of the field in which he spent a life time of effort as did Dr. Shaw.

Fortunate are those who had associations with William T. Shaw.—A. E. Culbertson.

PAUL RODE: 1901–1948

Paul Rode, the son of Camille and Clotilde Rode, was born at Saint Ouenne, Deux Sèvres, France, on 8 February 1901 and died in Paris, France, on 23 September 1948, of pneumonia. He was married in Paris, on 29 December 1927, to Renée Pougnard. He is survived by his wife and his mother.

Paul Rode, a member of the American Society of Mammalogists, was Laureat of the

French Academy of Sciences, of the Academy of Medicine, and of the Société Nationale d'Acclimation de France as well as a member of several societies. Both of his academic degrees, Licencié ès Sciences Naturelles in 1925 and Doctor of Natural Science in 1929, were from the Sorbonne. He was histological technician in 1926 in the laboratory of Professor Prenant of the Medical Faculty of Paris, physiological technician in 1927 under Professor Gautrelet in the same faculty, and in 1929 worked in bacteriology at the Pasteur Institute. Also, he had experience in the secondary and high school and in the National Institute of Agronomy before taking the post of Assistant to the Chair of Mammals and Birds in 1931 at the National Museum of Natural History in Paris where he did his most notable scientific work.

His doctoral dissertation on the sensory apparatus of fishes was published in parts as several separate papers. More than a hundred of his publications were on mammals; the titles of some of the longer works were: Les Mammifères de France, Les Primates de l'Afrique, Atlas de Mammifères de France, Mammifères ongulés de l'Afrique noire, Les Singes anthropoides and Les Chauves-souris de France. His shorter papers reveal his interest in morphology, serology, taxonomy, habits, economic importance of mammals to man, and other phases of mammalogy. Several of his papers were written in joint authorship with the eminent Paris surgeon, Doctor Robert Didier. This longtime association was indeed fortunate for mammalogy since the two men accomplished much more by collaborating and combining their resources than they would have by working independently.

Paul Rode traveled to French West Africa in 1935–36, visited the British Museum in 1936, and the United States in 1938, when, as many members of the American Society of Mammalogists will remember, he attended the annual meeting of the Society held that year in Berkeley, California. He was in Switzerland in 1947, and from 1946 to 1948 visited several of the French Provinces in his capacity of Inspector General of Provincial Museums of Natural History. It was in 1946 that, as a matter of duty, he accepted that post and also the one as Chief of Natural History Museums in the National Service. In 1948 he looked forward to appointment to the Professorship of Zoology in the Paris Museum of Natural History—because it would allow more time for research. French mammalogy, and mammalogy in general, suffered a very real loss in his untimely death.

In Paris he segregated in light-proof, dust-proof quarters the many type specimens of mammals contained in the Museum. Virtual completion of this great task made it easy and satisfactory for visiting mammalogists readily to consult the types "que constituent des documents des plus précieux, pour les naturalists" as the editorial committee of Mammalia, the French Mammal Journal, put it in the September, 1948, number of that publication, where the reader will find a fuller account than is given here of our distinguished fellow member. His faithful and efficient service on the editorial board of that journal took much of his time from 1936 until his death.

Perhaps no other man has been so nearly universally liked by those who knew him as was Paul Rode, both by his own countrymen and by those from other countries. The practical approach which he took to problems, his industry, modesty, cordial simplicity, sympathetic understanding of the problems and needs of other persons, and his every ready willingness to render service and help were combined with a natural personal charm which made him both the respected adviser and the close personal friend of nearly everyone who knew him.

Mindful of our own loss, we, the members of the American Society of Mammalogists, extend our sympathy to his gracious widow, his elderly mother, and his French Colleagues. —E. Raymond Hall, for the Society.

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